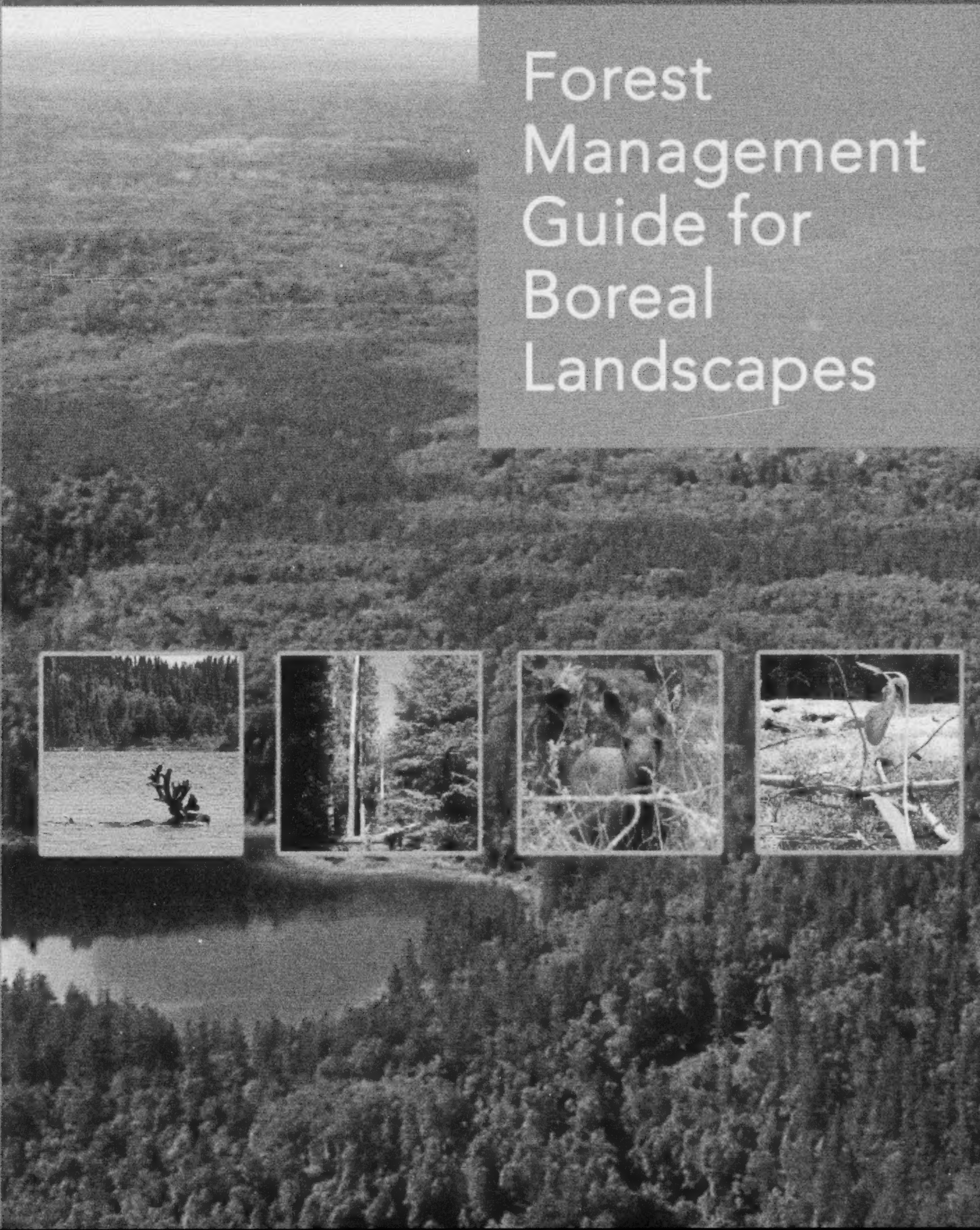
Ministry of Natural Resources

Ontario

*Natural. Valued. Protected.*

# Forest Management Guide for Boreal Landscapes



# Forest Management Guide for Boreal Landscapes

## 2014

Cette publication spécialisée n'est disponible qu'en anglais en vertu du Règlement 411/10, qui en exempte l'application de la Loi sur les services en français.

2014, Queen's Printer for Ontario
Printed in Ontario, Canada

Publications and price lists are available from this office:

ServiceOntario Publications
300 Water Street
P.O. Box 7000
Peterborough, ON K9J 8M5
1-800-668-9938
www.serviceontario.ca/publications

Telephone inquiries should be directed to the Service Ontario Contact Centre:

General Inquiry 1-800-668-9938
Renseignements en Français 1-800-667-1840
FAX (705) 755-1677

Other government publications are available from:
ServiceOntario Publications, Market level (lower), 777 Bay St., Toronto

Visit the Ontario's Forests website at:
http://www.ontario.ca/forests

Visit the Ontario Ministry of Natural Resources website at:
http://www.ontario.ca/mnr

Cover photos provided by: Ted Armstrong, Phil Elkie, Lindsay MacLean and Kevin Ride.

How to cite this manual:
OMNR. March 2014. Forest Management Guide for Boreal Landscapes.
Toronto: Queen's Printer for Ontario. 104 pp.

MNR Number: **62826** (Print)
MNR Number: **62827** (PDF)

ISBN: **978-1-4606-3670-1** (Print)
ISBN: **978-1-4606-3671-8** (PDF)

## Table of Contents

List of Figures ..... v
List of Tables ..... vii
Dedication ..... viii
Acknowledgements ..... viii

How to use this guide ..... 1

1 Introduction ..... 2
  1.1 Objective of the Landscape Guide ..... 2
  1.2 Key Concepts ..... 2
    1.2.1 Effectiveness ..... 2
    1.2.2 Efficiency ..... 3
    1.2.3 Landscape Guide Regions ..... 4
    1.2.4 Guides, Standards, Guidelines and Best Management Practices ..... 5
  1.3 Policy Background ..... 5
    1.3.1 MNR's Strategic Direction ..... 5
    1.3.2 Legislative Context ..... 6
    1.3.3 The Revised Forest Management Guides ..... 7
  1.4 Implementation and Phase-In Provisions ..... 7
    1.4.1 Previous Guides Replaced ..... 7
    1.4.2 Implementing the Landscape Guide in Phase I (first five year term) of Forest Management Plans ..... 7
    1.4.3 Applying the Landscape Guide to Phase II (second five year term) of Forest Management Plans ..... 8
    1.4.4 Addressing *Endangered Species Act, 2007* Implementation Requirements ..... 9

2 Development of the Landscape Guide ..... 10
  2.1 People Involved ..... 12
    2.1.1 Development Team ..... 12
    2.1.2 Science Team ..... 12
    2.1.3 Provincial Forest Technical Committee ..... 12
    2.1.4 Practitioner Experience ..... 12
    2.1.5 Forest Management Planners ..... 13
    2.1.6 Public Engagement ..... 13
  2.2 A Changing Management Approach ..... 13
    2.2.1 Featured Wildlife Species Approach ..... 13
    2.2.2 The Coarse and Fine Filter Management Approach ..... 16
    2.2.3 Comparison of Featured Wildlife Species Guidelines to Coarse Filter Direction . 17
  2.3 Understanding Ranges of Natural Variation ..... 18
    2.3.1 Climate Change and the Landscape Guide ..... 23
  2.4 Evaluating Alternative Management Options ..... 24
    2.4.1 Developing Milestones ..... 24
    2.4.2 Pilot Testing the Landscape Guide ..... 25

3 Applying the Landscape Guide in a Forest Management Plan ..... 26
  3.1 Measure the Condition of the Current Forest Landscape ..... 26
    3.1.1 Structure and Composition ..... 30
    3.1.2 Pattern ..... 38
  3.2 Woodland Caribou ..... 42
    3.2.1 Texture of Woodland Caribou Habitat ..... 45
  3.3 Use Landscape Guide to Set Desirable Levels in FMP ..... 46

3.4 Develop Targets for Biodiversity Objectives ....... 46
  3.4.1 Develop Targets for Forest Dwelling Woodland Caribou Habitat Objectives ....... 47
3.5 Identify Large Landscape Patches to Meet Targets ....... 48
  3.5.1 Using Large Landscape Patches for Applying Fine Filter Direction for Moose or Deer ....... 49
  3.5.2 Using Large Landscape Patches for Applying Fine Filter Direction for Woodland Caribou ....... 50

4 Monitoring, Evaluating and Reviewing the Landscape Guide ....... 54
4.1 Effectiveness: Evaluating the effectiveness of the Landscape Guide ....... 54
4.2 Effects: Identifying effects on other values ....... 56
4.3 Efficiency: Reviewing the Landscape Guide ....... 57

5 Literature Cited ....... 58

Appendix 1. Landscape Guide Milestones for Landscape Guide Region 4S/3S ....... 65
Appendix 2. Landscape Guide Milestones for Landscape Guide Region 4W ....... 75
Appendix 3. Landscape Guide Milestones for Landscape Guide Region 3W ....... 81
Appendix 4. Landscape Guide Milestones for Landscape Guide Region 3E ....... 91

## List of Figures

Figure 1. Landscape Guide Regions of Ontario. Landscape Guide Regions in the shaded grey areas will use the Forest Management Guide for Boreal Landscapes, whereas the other Landscape Guide regions will use the Forest Management Guide for Great Lakes-St. Lawrence Landscapes. .......... 4

Figure 2. The adaptive management cycle that is proposed for development, implementation, monitoring and evaluating of the Landscape Guide. Green Boxes represent shared activities of management and science during develop and evaluate phases, whereas yellow and blue boxes represent parallel but separate activities of science and management (respectively) in the implement and evaluate phases. The development of the guide brought together science and management to combine goals, experience, knowledge, technology and inventory to develop an analytical framework from which landscape direction and testable hypotheses were developed (Adapted from Stankey et al. 2005.) .......... 10

Figure 3. A conceptual model showing the relationship between coarse and fine filters in habitat management. A coarse filter operates at a variety of spatial scales to: provide habitat for a very broad range of wildlife, to support interactions among wildlife species, and to facilitate ecosystem processes. A fine filter may be required for wildlife species whose needs are not captured by the coarse filter (for example, heron nests and moose aquatic feeding areas). Biodiversity is most likely to be conserved by hierarchical application of both filters on the landscape (figure courtesy of Kandyd Szuba). .......... 17

Figure 4. A schematic illustration of an adaptive cycle in a forest landscape (from Bunnel 2003). It shows that forest ecosystems are dynamic and can be thought of as following an adaptive cycle that has four phases: growth (r) , maturity (K), collapse (Ω) and reorganization (ά)... 19

Figure 5. A decision tree showing modelling iterations involving modifications by the science team and field practitioners to the BFOLDS model inputs. These inputs included landscape dynamics, (e.g. forest succession rules and disturbance sizes and cycles) landscape condition (e.g. forest cover and age) and model mechanics (e.g. how the BFOLDS simulated fire spread). Iterations continued until the PIC was simulated by BFOLDS........ 21

Figure 6. Example simulation information sheet. The SRNV was calculated by taking measurements of landscape indicator values at 50 year intervals (i.e., years 100, 150 and 200). The resulting SRNVs are expressed as box and whisker plots for non-spatial (i.e., amount) indicators or as a histogram for spatial/pattern indicators. .......... 22

Figure 7. An example SRNV information sheet for landscape class indicators. The SRNV is expressed as a box and whisker plot. Indicator values at year 0 of the modelling period (roughly 2006) shown as green dot. The red square represents the value 50 years into the simulation. .......... 32

Figure 8. An example SRNV information sheet for the old growth. The SRNV is represented by a box and whisker plot. Indicator values at year 0 of the modelling period (roughly 2006) shown as green dot. The red square represents the value 50 years into the simulation. .... 34

Figure 9. An example information sheet from Science Package A (Elkie *et al.* 2013b) the proportion of forest in red and white pine communities. A red and/or white pine community is defined as a stand that contains at least 40% of red and/or white pine combined as a proportion of the overall composition of the stand. .......... 36

Figure 10. An example SRNV information sheet for the conifer indicator. The SRNV is represented by a box and whisker plot. Indicator values at year 0 of the modelling period (roughly 2006) shown as green dot. ........ 37

Figure 11. Texture of the mature and old forest indicator. Concentrations of mature and old forest are mapped on the left hand side of the figure and quantified in a histogram on the right. 5,000 ha hexagons are used in this example with dark green hexagons having high (> 0.80 class) concentrations of mature and old forest and brown hexagons having a low (<0.20 class) amount. In this example, the majority of the landscape has relatively low concentrations (<0.60 class) of mature and old forest........ 39

Figure 12. Young forest patch size indicator report from Ontario's Landscape Tool (OLT). The histogram describes the relative proportion of young forest patches across the landscape (Y axis) by different patch size classes (X axis). ........ 41

Figure 13. Predicted relationships between pattern, composition, and structure and forest management disturbances versus natural disturbances. The boxes represent characteristics of disturbances (frequency, intensity and extent) or landscapes (structure, composition and pattern). Under the hypothesis that forest management (lower left box) emulates key characteristics of natural disturbances (upper left box) the use of the Landscape Guide is predicted to result in similarities between unmanaged landscape structure composition and pattern (upper right box) and the managed areas (lower right box). ........ 55

## List of Tables

Table 1. Comparison of habitat direction featured in wildlife species guidelines with comparable coarse filter direction....18

Table 2. Landscape Guide Indicators for Landscape Guide Regions 3S4S, 4W and 3W, arranged by CFSA category, Landscape Guide section heading, indicator name recommended order of application and units of measurement. Caribou habitat indicator is only applied in forest management units that are fully within or intersect caribou population ranges as identified in the Caribou Conservation Plan. Refer to section 3.1 for specific details on Landscape Guide indicators....28

Table 3. Landscape Guide Indicators for Landscape Guide Region 3E arranged by CFSA category, Landscape Guide section heading, indicator name, recommended order of application and units of measurement. Caribou habitat indicator is only applied in forest management units that are fully within or intersect caribou population ranges as identified in the Caribou Conservation Plan. Refer to section 3.1 for specific details on Landscape Guide indicators. ....29

Table 4. Forest units, development stages and landscape classes used in the Boreal West Forest Region. Each forest unit has a name, description, ages of onset of development stages with a colour coding indicating the corresponding landscape class for the forest unit development stage. ....31

Table 5. Forest units, development stages and landscape classes used in the Boreal East Forest Region. Each forest unit has a name, description, ages of onset of development stages with a colour coding indicating the corresponding landscape class for the forest unit development stage. ....31

Table 6. Conventional boreal caribou habitat models/classifications as defined in Science Package "C" using Northwest and Northeast Region forest units. A forest stand comes on-line as habitat when it reaches the onset age....44

Table 7 Claybelt boreal caribou habitat models/classifications as defined in Science Package C using Northeast Region forest units. A forest stand comes on-line as habitat when it reaches the onset age. ....45

## Dedication

This guide is dedicated to the children born to those involved in its development. They are our lasting approach to evaluating our effectiveness.

## Acknowledgements

The Forests Branch of the Ministry of Natural Resources (MNR) would like to thank the individuals who contributed to the development team for this guide. These individuals gave their personal time and took time away from their primary duties to provide MNR with their professional advice.

The development team advised MNR on the content and direction of the Landscape Guide to ensure it was efficient and effective and Ministry gratefully acknowledges the contributions of the development team: Michael Gluck[1], Joe Churcher[1], Phil Elkie[1], Colin Hewitt[2], Gillian MacEachern[3], David Pearce[3], Robert Pineo[4], Kandyd Szuba[5]

1 Ontario Ministry of Natural Resources, Forests Branch, Forest Policy Section
2 Abitibi Consolidated (now known as Resolute FP Canada Inc), representing Ontario Forest Industries Association
3 Canadian Parks & Wilderness Society - Wildlands League
4 Ontario Federation of Anglers and Hunters (currently employed with Ontario Ministry of Natural Resources)
5 Domtar (EACOM) (now retired), representing Ontario Forest Industries Association

Matt DeMille with the Ontario Federation and Anglers and Hunters assisted in the final stages of guide development.

Exceptional leadership of Brian Hillier and Joe Churcher of the Forest Policy Section must be acknowledged in allowing the Landscape Guide to be innovative and comprehensive.

This is a science-based policy that had exceptional support from the dedicated group of professionals that comprised the Boreal Science Team: Garnet Beemer, John Boos, Rob Bowen, Colin Bowling, Jeff Bowman, Phil Elkie, Dave Etheridge, Denis Gagnon, Michael Gluck, Glen Hooper, Rob Kushneriuk, Rodger Leith, Greg Lucking, Rob Mackereth, Mike Malek, Stephen Mills, Brian Naylor, Steve Osawa, Marc Ouellette, Ajith Perera, Fred Pinto, Bruce Pond, Gerry Racey, Rob Rempel, Kevin Ride, Art Rodgers, Andy Smiegielski, Bob Watt, Glen Watt, and Murray Woods.

Good forest management guides require good tools for successful implementation. Ontario's Landscape Tool was developed by Phil Elkie, Andy Smiegielski, Michael Gluck, Julie Elliott, Rob Rempel, Rob Kushneriuk, Brian Naylor, Jeff Bowman, Bruce Pond and Derek Hatfield.

The Provincial Forest Technical Committee provided MNR with thoughtful and constructive advice throughout the development of the Landscape Guide.

A final note of sincere appreciation to the public and to the numerous staff of MNR and forest industry companies for the professional support and comments that were submitted as a result of many workshops, meetings with the development team, informal communications and the Environmental Bill of Rights (EBR) registry postings.

## How to Use this Guide

The ***Forest Management Guide for Boreal Landscapes*** is one of a series of forest management guides used by forest managers when planning and implementing forest management operations. In order to protect or enhance environmental, recreational, and cultural heritage values, the series of guides provides direction to assist forest managers to decide, for example, what areas of forest to harvest (and equally important, what areas not to harvest), how large the harvest areas should be, and what harvesting and regeneration practices to use. An overview of the complete set of forest management guides and their role in the sustainable management of Ontario's forests is provided in the Ontario Forests Factsheet, *Forest Management Guides* (http://ontario.ca/forestguides).

The most efficient way to use the Forest Management Guide for Boreal Landscapes (hereafter referred to as the Landscape Guide) in Forest Management Planning is to follow these steps:

1. **Read** the Landscape Guide: The main body of the guide describes how the guide was developed, forest management planning (FMP) implementation steps and an approach to effectiveness monitoring of the guide direction.

2. **Refer** to the Landscape Guide Milestones Appendices for the applicable Landscape Guide Region. There are 6 Landscape Guide regions across Ontario. Each forest management planning unit has Landscape Guide direction contained within a single Landscape Guide region.

3. **Use** Ontario's Landscape Tool (OLT) (Elkie *et al.* 2013a) to measure and assess the landscape of interest. OLT is a computer-based tool that measures indicators described in the Landscape Guide and Appendices. OLT also contains science and information packages which describe the simulation models, results and supporting science used in the development of the guide.

4. **Incorporate** the Landscape Guide direction into forest management planning.

# 1 Introduction

## *1.1 Objective of the Landscape Guide*

The objective of the Landscape Guide is to direct forest management activities to maintain or enhance natural landscape structure, composition and patterns that provide for the long term health of forest ecosystems in an efficient and effective manner. For purposes of this guide, 'landscape' describes an area covering hundreds of thousands to tens of thousands of square kilometres, roughly equivalent to ecoregions (see section 1.2.3)

The Crown Forest Sustainability Act (CFSA) (1994) provides for the sustainability (long-term health) of Crown forests that are to be managed to meet social, economic and environmental needs of present and future generations. Ontario's forest management guides are based, in part, on the two CFSA principles that direct Ontario's forest management planning. The first principle mandates that large, healthy, diverse and productive Crown forests and their associated ecological processes and biological diversity should be conserved. The second principle directs that conservation should be achieved by using forest practices that, within the limits of silvicultural requirements, emulate natural disturbances and landscape patterns while minimizing adverse effects on forest values, including environmental, social, and economic values. These principles of the CFSA provide the direction for both the development of the Landscape Guide direction and the determination of its effectiveness. Emulation of natural disturbance and landscape patterns through forest management, directs how to conserve biodiversity (as is required under the Declaration Order regarding MNR's Class Environmental Assessment Approval for Forest Management on Crown Lands in Ontario (EA Condition 39)) and is treated as a hypothesis as discussed in section 2.3. The principal comparison for evaluating effectiveness of the Landscape Guide direction is between forests that have developed from natural processes versus those that have arisen through application of the forest management guides. The principal measurement, as mandated by the CFSA, is the conservation of biodiversity and ecological processes. Additional policy background is described later (Section 1.3); however, it is important to describe some key concepts that form the basis for the Landscape Guide.

Similar to all forest management guides, the mandate of this document is limited to Crown forests within the Area of the Undertaking (AOU) of Ontario (specifically those forests within the boreal forest region), and for any Crown forests within that forest region located outside the AOU for which MNR has Environmental Assessment approval to undertake forestry activities. The philosophy and direction provided may also be helpful when managing other Crown forests outside of the AOU and private forest lands.

## *1.2 Key Concepts*

### 1.2.1 Effectiveness

Key concepts in the CFSA principles such as conserving diverse and productive forests and their associated ecological processes and biological diversity with an explicit comparison to natural disturbances and landscape patterns are comparable to the concept of ecological integrity (Karr 1991). Integrity implies an unimpaired condition or the quality or state of being complete or undivided; it implies correspondence with some original condition (Karr 1996). A healthy ecosystem is able to respond to changing conditions and to maintain essential ecosystem functions. Functional systems, such as a community of soil organisms, provide nutrients to future trees and habitat for amphibians and small mammals through decomposition. Nest webs, such as those that include keystone woodpeckers, help to provide nesting and feeding habitat for a variety of wildlife. Although much is still to be learned, we know that the underlying habitat diversity, together with the flow of energy within integrated food webs, plays a critical role in sustaining the integrity of forest ecosystems (McCann 2007). Boreal plant and wildlife communities must be adaptive because environmental conditions never remain constant. Whether it is long-term cycles of solar activity, the effects of global increases in particular gases, or the adaptive cycles of exploitation, conservation, release, and reorganization (Gunderson and Holling 2002), environments will change. Genetic diversity and pathways of mobility are key elements for ensuring populations and communities can adapt to ever changing environmental conditions. As environments change through successional development stages, individual species will rise and fall in relative abundance.

The purpose of the CFSA is to ensure the long-term health of our forest ecosystems for the benefit of the local and global environments, while enabling present and future generations to meet their material and social needs. Meeting this purpose means, in part, that ecosystem patterns and processes reflect the composition, structure and function of comparable natural systems. Forest management should not negatively affect the provision of ecosystem services related to nutrient dynamics, primary and secondary production, habitat and predator-prey dynamics, hydrological cycles or pest and disease control. Forest management should not impede the ability of plant and wildlife communities to adapt to changing conditions. Genetic diversity and pathways of mobility are key elements for ensuring populations and communities can adapt to ever changing environmental conditions. A test of the effectiveness of the Landscape Guide would be based on the prediction that forest management will result in landscapes that are similar to those created from natural disturbance in terms of their community structure, population trends and ecological processes. Whether this prediction is borne out will be part of the review of the Landscape Guide. Section 4 describes this review and the approach to effectiveness monitoring in more detail.

### 1.2.2 Efficiency

Efficiency was considered to be the ease with which people can prepare, read and implement forest management plans using the Landscape Guide. The principle of efficiency was second only to effectiveness throughout the development of the Landscape Guide. Some examples of how efficiency was considered include:

- Streamlining the Landscape Guide direction to integrate with strategic forest management planning.
- Identifying parsimonious direction (standards, guidelines and best management practices) based on a Decision Analysis and Adaptive Management Approach (see section 2).
- Discussions with practitioners and others that provided feedback on proposed direction (see section 0).
- Using a coarse filter of emulating natural disturbances and landscape patterns as an efficient way to direct management.

OMNR will monitor the efficiency of the Landscape Guide through continuing discussions and feedback from those involved in the development and application of the Landscape Guide – like predictions on effectiveness, the predicted efficiencies will be considered in the future review of the Landscape Guide (section 4.3).

### 1.2.3 Landscape Guide Regions

The Landscape Guide uses a forest-centric approach to define landscapes based on natural factors that reflect structure, composition and function across space and time (Rowe and Sheard 1981, Franklin 1993). Ecoregions are ecological landscape units (ranging in resolution from hundreds of thousands to tens of thousands of square kilometres) characterized by distinct patterns of responses to climate as expressed by soils, hydrology, vegetation (species ranges and productivity), and fauna (OMNR 2000). Processes that operate at ecoregion scales include natural disturbance regimes, landscape composition and pattern, and population dynamics of some wildlife with large home ranges (e.g. caribou, wolves, moose, goshawk, great grey owl). Ecoregions were used to develop the Landscape Guide regions, which this guide considers as its landscape unit.

Landscape Guide Regions are groupings of Forest Management Units that approximate ecoregion boundaries (Figure 1). These regions have been designed such that Forest Management Units are nested within Landscape Guide Regions so that direction for individual Management Units may be given efficiently within an ecoregion context. Landscape Guide direction can vary among Landscape Guide regions to reflect significant ecological differences in landscape structure, composition and/or pattern. Each Landscape Guide region has its own Milestones Appendix which directs individual management units in their contribution to biodiversity conservation at the Landscape Guide region level. Landscape guide regions are also used in the approach to effectiveness monitoring (Section 4).

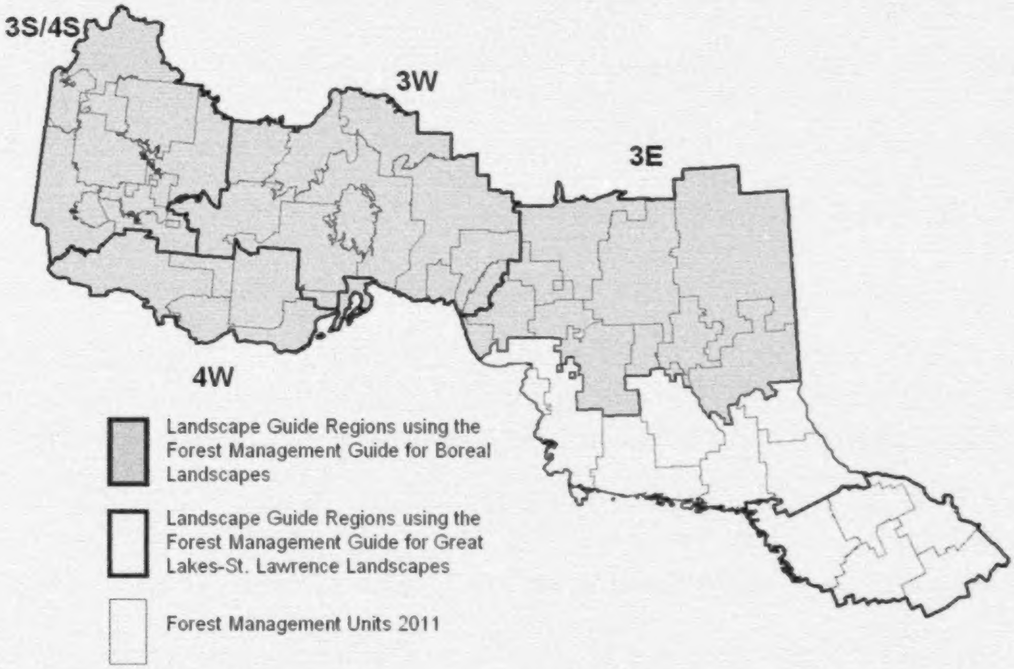

3S/4S
3W
3E
4W
Landscape Guide Regions using the Forest Management Guide for Boreal Landscapes
Landscape Guide Regions using the Forest Management Guide for Great Lakes-St. Lawrence Landscapes
Forest Management Units 2011

**Figure 1. Landscape Guide Regions of Ontario. Landscape Guide Regions in the shaded grey areas will use the Forest Management Guide for Boreal Landscapes, whereas the other Landscape Guide regions will use the Forest Management Guide for Great Lakes-St. Lawrence Landscapes.**

### 1.2.4 Guides, Standards, Guidelines and Best Management Practices

Direction within this document is characterized as a standard, a guideline, or a best management practice. It is important to understand the differences between these three terms since they have different implications with respect to writing a forest management plan.

- ***guide***: A document that contains direction (including past forest or timber management "guidelines").
- ***standard***: A component of a guide that provides mandatory direction. The Landscape Guide uses standards when precise direction is given.
- ***guideline***: A component of a guide that provides mandatory direction, but requires professional judgment for it to be applied appropriately at the local level. The Landscape Guide uses guidelines in order for professionals to incorporate knowledge and experience of local ecological conditions to improve the application of mandatory direction.
- ***best management practice***: A component of a guide that suggests a practice or strategy to help implement the overall purpose of the standards and guidelines (note that this is a revised definition from previous forest management guides).

Standards must be followed as written; there is no room for interpretation on the part of the planning team. Guidelines are also mandatory and must be followed, but require professional expertise and local knowledge in order to be implemented. They may be expressed as a range of values or may need to be implemented in different ways according to the site conditions or circumstances encountered. Best management practices are not mandatory direction, but rather are examples of practices that the planning team may wish to use. The list of best management practices is not intended to be exhaustive; planning teams may think of and implement other ideas or strategies. There is no requirement to use any of these best management practices, and a specific best management practice may not be applicable to local circumstances.

***Standards*** and ***guidelines*** are formatted in ***bold italic*** in the Landscape Guide. The formatted text is the actual standard or guideline. ***Best management practices*** are indicated as such but they have normal format.

## *1.3 Policy Background*

### 1.3.1 MNR's Strategic Direction

The Ministry of Natural Resources (MNR) is the steward of Ontario's provincial parks, forests, fisheries, wildlife, mineral aggregates, and the Crown lands and waters that make up 87 per cent of the province. This is a major responsibility which MNR manages through a diverse legislative mandate and an array of programs aimed at meeting the needs of a broad client base.

The Ministry envisions a healthy environment that is naturally diverse and supports a high quality of life for the people of Ontario through sustainable development. The Ministry's mission is to manage Ontario's natural resources in an ecologically sustainable way to ensure that they are available for the enjoyment and use of future generations. The Ministry is committed to the conservation of biodiversity and the use of natural resources in a sustainable manner.

In 2008 the MNR revised its Statement of Environmental Values (SEV) under the Environmental Bill of Rights (EBR). The SEV is a document that describes how the purposes of the EBR are to be considered whenever decisions that might significantly affect the environment are made in the Ministry. The Ministry has considered its SEV during the development of the Forest Management Guide for Boreal Landscapes. This document is intended to reflect the direction set out in the SEV and to further the objectives of managing our natural resources on a sustainable basis.

### 1.3.2 Legislative Context

The two key pieces of legislation that govern forest management on Crown land in Ontario are the *Crown Forest Sustainability Act* (CFSA) and the *Environmental Assessment* (EA) *Act*.

As noted earlier, Landscape Guide objectives to emulate natural disturbances and landscape patterns are based on one of the principles of the CFSA. The CFSA also requires the development and distribution of four regulated manuals, two of which give legal context to the forest management guides. The *Forest Management Planning Manual* (FMPM) requires that forest management guides be used during the preparation of a forest management plan. Similarly, the *Forest Operations and Silviculture Manual* lists the various policies, including the forest management guides that relate to forest operations on Crown land.

The CFSA, through its regulated manuals, requires that forest management guides be used in the preparation of a forest management plan. For purposes of monitoring compliance, it is important to realize that the approved forest management plan is the legal instrument against which forest operations are compared. What occurs on the ground is compared to what is written in the approved plan, not what is found in this guide. Therefore, it is necessary to include the direction from this guide that is relevant to particular locations and operations in the appropriate portion of the forest management plan, as required by the Forest Management Planning Manual.

Using the forest management guides during the planning and implementation of forest management activities is also a legal requirement under MNR's class environmental assessment approval for forest management on Crown lands in Ontario as set out in Declaration Order MNR-71, as amended by MNR-71/2, under the *Environmental Assessment Act* (Condition 38a). Other parts of Condition 38 include posting the status of current guides on the Internet; reviewing and, where necessary, revising each guide at least every five years; reflecting up-to-date scientific knowledge in the guides; where feasible and with the advice of the Provincial Forest Technical Committee, pilot testing new direction before it is finalized; describing the approach to the effectiveness monitoring program that will be implemented for the new guide; and providing opportunities for public review of draft guides, through the Environmental Bill of Rights Registry, and access to final guides, through MNR's Internet site. Other conditions of the declaration order relate indirectly to the forest management guides, most notably Condition 31, the continuation of a program of scientific studies to assess the effectiveness of the guides, and Condition 37, the maintenance of the Provincial Forest Technical Committee as a public advisory committee to the Assistant Deputy Minister, Forests Division with respect to content of and changes to forest management guides.

Ontario passed a new Endangered Species Act in 2007 which replaced Ontario's original Endangered Species Act of 1971. This new Act provides broader protection for species at risk and their habitats and a stronger commitment to recovery of species. The *Forest Management Planning Manual* requires planning teams to identify appropriate management approaches for species at risk known to occur in forest management units. These management approaches may be based on specific policy direction, if it exists, provided under the *Endangered Species Act, 2007*. Management direction for most species at risk that may be affected by forest operations is addressed in the *Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales*. Given the landscape level habitat requirements of forest dwelling woodland caribou, the Landscape Guide addresses caribou habitat. Refer to section 1.4.4 for a discussion of the relationship between the landscape guide and the *Endangered Species Act, 2007* (ESA).

There is also other provincial and federal legislation that must be followed during forest operations. These laws formed part of the rationale behind the development of the specific direction in this guide. If there are inconsistencies or gaps between federal or provincial legislation and the direction in this guide, however, the legislation will always take precedence.

### 1.3.3 The Revised Forest Management Guides

Ontario's Forest Accord (1999), an agreement between MNR, the forest industry and the Partnership for Public Lands supported a transparent review of the forest management guidelines which are applied within forest management planning with a goal of ensuring the guidelines fulfill their intended purpose in an effective and efficient manner. In 1999 MNR hired independent consultants to review the existing forest management guides for ambiguity and redundancy. The consultants were asked to provide recommendations about how to improve the efficiency and usability of the guides, while maintaining and respecting the original intent of the guides which was to provide sound forest management direction. The final report listed 80 recommendations to improve the guides (Arborvitae *et al.* 2000). For example, MNR needed to be more careful and consistent in the wording used to describe the direction provided in each guide. One of the most important, was to restructure the material and consolidate the guides into a fewer number of documents. Further examination of this recommendation resulted in a decision to create a new suite of five guides. These two recommendations, along with 78 others, were accepted by MNR to review existing guides, as described in the Implementation and Phase-In Section.

## *1.4 Implementation and Phase-In Provisions*

### 1.4.1 Previous Guides Replaced

For the boreal guide regions (Figure 1), this guide replaces the landscape level direction in the following forest management guides:

- Forest management guide for natural disturbance pattern emulation (OMNR 2001)
- Forest management guidelines for the provision of marten habitat (OMNR 1996a)
- Forest management guidelines for the provision of pileated woodpecker habitat (OMNR 1996b)
- Forest management guidelines for the provision of white-tailed deer habitat (OMNR 1997)
- Timber management guidelines for the provision of moose habitat (OMNR 1988)

This guide also replaces the following forest management guide in its entirety:

- Forest management guidelines for the conservation of woodland caribou: a landscape approach (Racey *et al.* 1999).

This volume of the Landscape Guide is written for the boreal forest region. A separate volume of the landscape guide is available for the Great Lakes – St. Lawrence forest region.

### 1.4.2 Implementing the Landscape Guide in Phase I (first five year term) of Forest Management Plans

***This version of the Landscape Guide will be used in its entirety in the preparation of forest management plans in the Boreal Landscape Guide Regions (Figure 1) scheduled for implementation on or after April 1, 2017 (standard).***

Plans that are being prepared for implementation on or before April 1, 2016, but are delayed, will not be required to apply the Landscape Guide. The approved Long Term Management Direction (LTMD) for these delayed plans will remain valid.

Some teams developing forest management plans scheduled for approval on or after April 1, 2011 relied on the theory and science supporting this guide (e.g. the concept of Simulated Ranges of Natural Variation and associated milestones) to help them develop their long term management direction. This was undertaken to meet the direction in the Forest Management Planning Manual to consider "... the best available science and information, new legislation, regulation and policy ..." when establishing the plan's long term management direction (FMPM 2009, Part A, Section 1.2.4). For planning teams managing forest dwelling woodland caribou habitat as part of their 2011, 2012, 2013. 2014, 2015 or 2016 FMP, use of the supporting science and information also facilitated their consideration of the Caribou Conservation Plan, as discussed in sections 1.4.4 and 3.2.

### 1.4.3 Applying the Landscape Guide to Phase II (second five year term) of Forest Management Plans

There will be two types of forest management plans to be prepared for Phase II (second five year term) – those that had prepared 10-year plans with the Landscape Guide, and those that had not.

#### 1.4.3.1 Forest Management Plans with Phase I Written Without the Landscape Guide

***Forest management plans written prior to implementation of the Landscape Guide are not required to update the Long Term Management Direction or the landscape indicators in FMP-9 based on the Landscape Guide (standard).***

***For Phase II of those forest management plans that are within or intersect continuous caribou range, the stand and site scale fine filter direction related to caribou habitat (described in Section 3.5.2.1) will be applied, beginning in 2015. Application of the fine filter direction will follow the principles and objectives in the approved Long Term Management Direction and will be consistent with the landscape composition and pattern objectives (guideline).***

Where the fine filter direction refers to Large Landscape Patches, the direction will apply to the caribou habitat mosaics identified during the preparation of Phase I of the FMP.

#### 1.4.3.2 Forest Management Plans with Phase I Written With the Landscape Guide

Teams that did apply the Landscape Guide to develop 10-year FMPs will be planning operations for the second five-year term starting in 2022. During Phase I, Stage Three (Operational Planning), the spatial assessment of sustainability will be updated and documented in the final version of FMP-9. This includes landscape scale spatial assessments of the effects of planned operations for both the first five-year term and the second five-year term of the Forest Management Plan. A similar assessment is not done in Phase II planning. Rather, at this stage the assessment is done through the annual reporting process.

***During Phase II (second five year term) the Landscape Guide will be used two ways (guideline):***

1. ***determine whether the long-term direction remains valid for the second five-year-term; part of this determination will consider biodiversity objectives that were developed with the Landscape Guide***

2. ***use the Landscape Guide pattern indicators (section 3.1.2) to evaluate the ability of the management unit to meet the spatial objectives of the forest management plan***

### 1.4.4 Addressing *Endangered Species Act, 2007* Implementation Requirements

As previously noted, the objective of the Landscape Guide is to direct forest management activities to maintain or enhance natural landscape structure, composition and patterns that provide for the long term health of forest ecosystems in an efficient and effective manner. This guide represents MNR's evolving approach to biodiversity conservation, applying a coarse and fine filter to forest management (see section 2.2) including the provision of habitat for species at risk.

An immediate challenge in responding to *Endangered Species Act* (2007) implementation is addressing the conservation of habitat for forest dwelling woodland caribou which is listed as threatened. Ontario approved the Woodland Caribou Conservation Plan (CCP) in 2009 which, amongst a number of requirements, committed MNR to utilize the approaches and science-based models being developed for the draft Landscape Guide to address the amount, pattern and distribution of woodland caribou habitat over time in forest management planning (CCP Action item 4.1.1) (OMNR 2009). To meet this CCP commitment, teams developing forest management plans that came into effect in 2011, 2012, 2013, 2014, 2015 and 2016 used the science and theory that supports this guide, as contained in the guide's complementary Science and Information Packages. Meanwhile, some approved FMPs used the scientific rationale associated with this guide to draft plan amendments to meet the requirements associated with the CCP. For 2017 and subsequent forest management plans, following the direction in this guide will be an integral component of implementing the CCP, as discussed in detail in section 3.0.

With respect to forest management operations, this guide provides science-based information and direction for forest-dwelling woodland caribou, which is a species at risk in Ontario's forests whose range approaches a landscape scale. The direction in this guide represents science-based guidance intended to minimize the risk that forest management operations might incidentally kill, harm, or harass caribou, or damage or destroy their habitat. Direction in this guide may be superseded by any future direction provided by the MNR with respect to measures or actions that may be required in order to comply with the ESA. Planning teams may also need to refine or enhance prescriptions and protection measures to address specific local situations. Planning teams should consult MNR species at risk biologists for advice and direction on the implementation of ESA requirements.

Future habitat descriptions, habitat regulations, or associated policy documents (e.g. additional policies developed in response to CCP commitments) developed under the ESA may contain additional direction that supersedes direction in this guide and that must be followed to ensure compliance with the ESA. When completed, these documents will be available through MNR's species at risk website (www.ontario.ca/SpeciesAtRisk) and should be consulted for the most recent direction. Any regulations made to prescribe areas as habitat in a species-specific habitat regulation will also be available on e-laws (www.e-laws.gov.on.ca/index.html).

## 2 Development of the Landscape Guide

As recognized in "Our Sustainable Future" (OMNR 2005), our understanding of the way the natural world works and how our actions affect it is often incomplete and we should exercise caution and special concern for natural values in the face of this uncertainty. The Landscape Guide deals with "caution and special concern" by applying principles of adaptive management (e.g. Holling 1978, Walters 1986, Baker 2000) and decision analysis (Howard 1966) (see Crawford *et al.* 2005 for a comparison of these concepts). The goal of adaptive management is to speed the process of learning by treating policies as hypotheses, and developing monitoring and research programs that directly test the effectiveness of the polices and guidelines. This interface between science and policy forms the foundation of Forest Management Guide development and testing. Adaptive management links science and policy to enable the development of policy through a cycle that facilitates continuous improvement to practices using a four-phase adaptive management cycle (Figure 2).

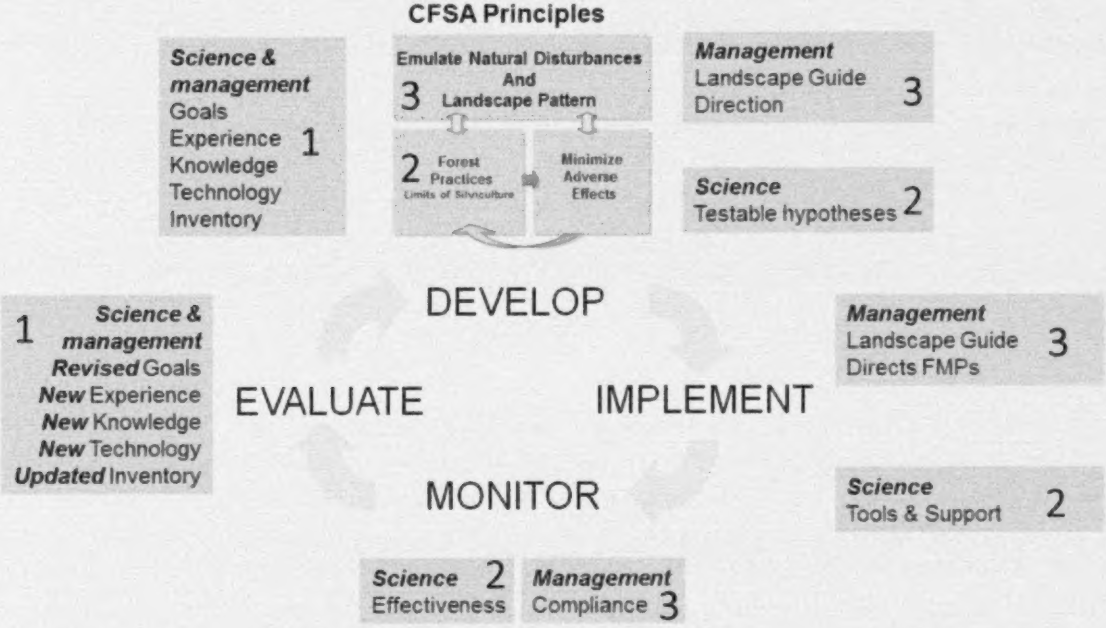


**Figure 2. The adaptive management cycle that is proposed for development, implementation, monitoring and evaluating of the Landscape Guide. Boxes with a "1" represent shared activities of management and science during develop and evaluate phases, whereas boxes with a "2" and "3" represent parallel but separate activities of science and management (respectively) in the implement and evaluate phases. The development of the guide brought together science and management to combine goals, experience, knowledge, technology and inventory to develop an analytical framework from which landscape direction and testable hypotheses were developed (Adapted from Stankey et al. 2005.)**

Jones and Nudds (2003) outlined a Decision Analysis and Adaptive Management (DAAM) process for policy development that provides additional detail on the "develop" phase of Figure 2. It is described below with links to the applicable sections of the Landscape Guide.

1. *Involve as many parties as possible.* Section 0 lists the people involved in the development of the guide and the roles they played.
2. *Specify management objectives and options.* Section 1 describes the management objectives of the Landscape Guide. Section 2.2 describes how a changing management approach of the Landscape Guide direction, based on emulation of natural disturbances and landscape patterns, is an alternative to the featured wildlife species approach of previous forest management guides.
3. *Identify the main uncertainties, as hypotheses and examine evidence for alternative hypotheses.* Section 2.3 identifies how quantifying the adaptive cycles of naturally disturbed landscapes, including disturbance regimes, forest succession pathways and habitat function are the main uncertainties of the Landscape Guide. This section also describes how Simulated Ranges of Natural Variation (SRNV) were developed as a result of critical evaluation of various sources of information describing disturbance regimes, forest succession pathways, and habitat requirements conducted by the science team and consultation with MNR and non-MNR experts using analysis of current and pre-industrial forest conditions.
4. The science and development team used regional workshops and informal review of these inputs in order to *evaluate and rank competing hypotheses by likelihood in light of uncertainty.* The outcome of this review was used to refine the SRNV or select alternative hypotheses to use for management options (e.g. pre-industrial conditions).
5. *Develop models to forecast outcomes, given different hypotheses.* The science team created strategic forest management model (SFMM and Patchworks) simulations in order to forecast outcomes of alternative ways to move or maintain the landscape within the SRNV. The development and science teams used these models to assess combinations of potential standards and guidelines as alternative ways to emulate natural landscape patterns.
6. *Evaluate alternative management options.* The Landscape Guide Development Team evaluated options based on literature and modeling results. Section 0 describes the process of developing milestones, which were the result of an evaluation of alternative management options of following Landscape Guide direction. This process compared alternative management options to move towards or maintain the landscape within the SRNV. This section also discusses pilot testing of the Landscape Guide which contributed to the development of Landscape Guide direction.
7. *Select management options.* Section 3 of the Landscape Guide contains the direction (standards, guidelines and best management practices) for forest management planners to follow.
8. *Select the highest uncertainties in the Landscape Guide direction.* Section 4.1 of the Landscape Guide identifies some of the highest uncertainties related to the Landscape Guide direction.

The remaining DAAM steps are addressed in detail in Guide Effectiveness Monitoring: Strategic Direction (Rempel *et al.* 2011) and will inform future review of the Landscape Guide discussed in section 4.3.

9. *Design and implement a hypothesis-based monitoring program to evaluate effectiveness of policy options (i.e. the Landscape guide direction), according to sound principles of experimental design.*
10. *Monitor key responses.*
11. *Update ranking of alternative hypotheses by likelihood to achieve desired outcomes given monitoring results.*

## *2.1 People Involved*

One of the first steps in the development of the Landscape Guide was to provide non-exclusive participation in the process through a variety of ad-hoc groups at provincial and local levels. These groups, described below, helped to iteratively refine the problem statement and analyze the management direction that is required and appropriate to help meet the objective of the guide (Lee 1993).

### 2.1.1 Development Team

A multi-disciplinary team provided OMNR with advice and guidance on how to *develop* the Landscape Guide. They ensured that the guide took a holistic approach to the management of forested landscapes, built upon past forest management experience and filled gaps in direction. In addition to their technical and professional experience, development team members were affiliated with the Ontario Forest Industries Association, Canadian Parks and Wilderness Society - Wildlands League, and Ontario Federation of Anglers and Hunters and sought ideas from members of these organizations as the Landscape Guide was developed.

### 2.1.2 Science Team

A comprehensive science team made up of natural resource science and management experts was formed to *support* the development team in predicting and evaluating the effectiveness and effects of possible forest management guide direction. The science team created an analytical framework that allowed the development team to take an adaptive management approach to guide development. In addition, they provided results of applicable scientific research, the results of relevant and appropriate monitoring programs, advantages and disadvantages of changes to current forest management practices, advances in analytical and operational technology, and extensive landscape-level scenario analyses. Additional discussions occurred with science advisors from Canadian Forestry Service, Canadian Wildlife Service, various universities, and natural resource agencies in other provinces.

### 2.1.3 Provincial Forest Technical Committee

The Provincial Forest Technical Committee (PFTC) is a group that advises the Assistant Deputy Minister, Policy Division about how to ensure that forest management guides are kept current with respect to scientific knowledge and management practices by acting as a review board for these guides. The PFTC received regular reports on the Landscape Guide development process and were provided with opportunities to participate in various aspects of the development process. PFTC advice on the development of the Landscape Guide was incorporated throughout guide development.

### 2.1.4 Practitioner Experience

Development team members sought advice from forestry and biology practitioners' experience in forest management planning by field visits, discussing related management costs, operational realities and experience with previous management guides, and input to forest management simulation modelling (section 0). These discussions were invaluable in ensuring efficiency in the development of the Landscape Guide.

### 2.1.5 Forest Management Planners

Workshops were held through 2007, 2008 and 2009 in the Boreal Landscape Guide Regions. Foresters and biologists who had local knowledge of the landscape and experience in forest management planning provided input to landscape simulation model inputs and development of forest management simulation modelling.

### 2.1.6 Public Engagement

The public was engaged in the development process through discussions in which ideas were exchanged to improve the content and direction of the Landscape Guide including:

- Presentations to all three Regional Advisory Committees
- Presentations to some Local Citizens Committees
- Multiple presentations to forest industry groups, environmental organizations (e.g. Wildlands League, Forest Ethics, Greenpeace, Ecojustice, Earthroots, Wildlife Conservation Society), local trappers councils and local field naturalists

## *2.2 A Changing Management Approach*

Section 1 describes the objective of the Landscape Guide. The review and revision of previous forest management guides that led to the development of this guide provided an opportunity to compare two forest management options for biodiversity conservation: 1) the featured wildlife species approach, which was in use prior to the Landscape Guide; and, 2) the coarse and fine filter approach to management in which emulating natural disturbances and landscape patterns is the coarse filter and specific habitat provisions, like those found in featured wildlife species approach are provided, if necessary, as fine filters. This section describes the featured wildlife species approach used in previous forest management guides and the coarse and fine filter approach, followed by a comparison of the two.

### 2.2.1 Featured Wildlife Species Approach

The featured wildlife species approach to managing wildlife habitat is based on the assumption that managing habitat for a selected species will accommodate the habitat needs of most wildlife species. This approach to wildlife habitat management was adopted by Ontario and used for a number of years (OMNR 1990). The following sections describe the landscape-level habitat management direction for those species of wildlife which had been identified as featured species (featured species which did not have landscape-level habitat management direction are not discussed).

#### 2.2.1.1 Timber Management Guidelines for the Provision of Moose Habitat

Moose are a socially and economically important resource whose populations and habitat are protected and enhanced to provide opportunities for recreation and continuous social and economic benefit for the people of Ontario. Ontario developed moose management strategies to meet the goals established for the moose management policy (OMNR 1980, currently under review) including harvest control, population management, enforcement, inventory and assessment, research, allocation, hunter education and habitat management. The habitat management strategy of the moose policy addressed landscape-scale forest management by directing wildlife managers to work closely with forest managers to produce moose habitat which approximates the habitat created by a relatively large forest fire of medium intensity. The Timber Management Guidelines for the Provision of Moose Habitat directed the production of relatively small (80-130 ha), irregular shaped cuts, scattered shelter patches and a high diversity of age class and tree species stands.

Moose habitat is characterized at the landscape scale by the availability of browse, cover, and special habitats. Browse and cover can be provided through application of the Landscape Guide composition, structure and pattern direction (e.g. Rempel *et al.* 1997); direction for the provision of special habitats can be found in the Stand and Site Guide. Moose can use heterogeneous landscapes of young forest that produce browse mixed with relatively small patches of older conifers or other habitat types as cover habitat. If there are few or no suitable patches of cover habitat interspersed in mostly feeding habitat, moose may need to move considerable distances to find cover. The ability of moose to move between cover and feeding habitats depends upon a number of factors, such as time of year, weather, snow characteristics, the quality and quantity of cover and forage, etc. (Hundertmark 1998, Renecker and Schwartz 1998). Moose are animals that benefit from forest edges, particularly edges that provide food (browse) in close proximity to cover. Thus, the suitability of a patch as winter feeding or cover habitat – or both -will depend strongly on the ratio of young forest to residual, mature conifer. Highly interspersed areas provide a greater likelihood of the area functioning as feeding habitat, whereas low interspersion mature areas will more likely be moose cover habitat.

#### 2.2.1.2 Forest Management Guidelines for the Provision of White-tailed Deer Habitat

The Forest Management Guidelines for the Provision of White-tailed Deer Habitat (OMNR 1997) suggested that maintenance or creation of particular landscape characteristics important to deer (percent of forest types and age classes, forest patch size and distribution, etc) will increase the likelihood that all the biological diversity associated with the landscape will be perpetuated (Voigt *et al.* 1992). Specifically, 10-15% of the landscape should be in forage and thermal cover that is arranged together in winter concentration areas known as deer yards. Where they exist, deer yards are used during the winter, and the major cover is provided by conifer species. Although the value of different conifer species varies because of their crown shapes and leaf characteristics, the key indicator is crown closure. Coniferous trees enhance winter habitat by intercepting snowfall which allows deer to conserve energy and retain mobility and access to food supplies (Mattfeld 1974, Hanley and Rose 1987). The three most important features of a successful deer yard are traditional use, cover, and browse (OMNR 1997).

FMP Application
***OMNR (1998c) procedures to identify active deer yards will be used in application of the Landscape and Stand and Site Guide (standard).***

#### 2.2.1.3 Forest Management Guide for the Provision of Marten Habitat

The Forest Management Guide for the Provision of Marten Habitat (OMNR 1996a) was written in response to the 1994 EA decision to include featured wildlife species that have mature forest habitat requirements. Landscape level direction in the marten guide was intended to provide habitat for martens, and, in so doing, to influence the supply and arrangement of mature and older conifer-dominated forest across the boreal landscape.

The main landscape level direction of the marten guide was to maintain 10 - 20 percent of the forest, which has the capability to produce marten, in suitable conditions. Suitable conditions were directed in the guide as mature forests with greater than 40 percent spruce, fir or cedar arranged in large patches of 3000 to 5000 ha. Fryxell et al. (2008) found that marten habitat could be more generally expressed as mature forest older than 50 years with greater than 30 percent of *all* conifer species. Recent research (Naylor *et al.* 2005) found no difference in marten harvest by trappers between areas that had large patches (≥3000 ha) of habitat and those in which habitat patches were smaller. However, patches of habitat at least the size of home ranges (≥ 500 ha) may be necessary. The results of this research were used to develop the Landscape Guide indicators for structure, composition and pattern.

#### 2.2.1.4 Forest Management Guide for the Provision of Pileated Woodpecker Habitat

Landscape level direction in the Forest Management Guide for the Provision of Pileated Woodpecker Habitat (OMNR 1996b) was intended to provide habitat for pileated woodpeckers and, in so doing, to influence the supply and arrangement of upland mature and older forest across the GLSL landscape. Research suggests that a coarse filter emulation of natural disturbance supplies the composition and patch size required for pileated woodpecker habitat (Bush 1999).

#### 2.2.1.5 Forest Management Guidelines for the Conservation of Woodland Caribou: A Landscape Approach

The original forest management guidelines for the conservation of woodland caribou (herein called the caribou guide) (OMNR 1999) provided direction for landscape planning at regional and local levels in woodland caribou (*Rangifer tarandus caribou*) range of northwestern Ontario. One objective of the caribou guide (Racey *et al.* 1999) was to plan landscapes with the objective of maintaining a continuous supply of suitable, year-round habitat distributed geographically and temporally across the landscape in a manner that would ensure permanent and continuous range occupancy. The strategy for meeting this objective was to plan a series of disturbance events following the Forest Management Guide for Natural Disturbance Pattern Emulation (OMNR 2001) with the goals to: i) maintain current supply and ensure a continuous supply of large areas (> 10,000 ha) containing winter and refuge habitat, ii) account for the existing distribution of caribou, and iii) provide access to alternate and future habitat.

In Ontario, forest dwelling woodland caribou are classified as threatened (Endangered Species Act, 2007 S.O. 2007, CHAPTER 6), and Ontario has recently developed a Woodland Caribou Conservation Plan (CCP) (Racey *et al.* 2009) that provides broad policy direction specific to woodland caribou conservation and recovery. This Landscape Guide supports the CCP by guiding forest management to maintain or enhance the quality, quantity and arrangement of habitat within the continuous distribution zone of forest dwelling woodland caribou within the landscape guide regions. Section 3.5 of this guide describes how strategic landscape mapping of management areas to conserve biodiversity will include the consideration of the quantity and arrangement of current and future caribou habitat within the natural limits of forest variability as estimated with simulation models and expressed as simulated ranges of natural variation.

#### 2.2.1.6 Species at Risk

Species at risk, which are native plants and animals at risk of extinction or of disappearing from the province, are listed under Ontario's Endangered Species Act (S.O. 2007, Chapter 6). Species at risk receive special consideration in forest management (see section 1.3.2). This guide provides direction for forest-dwelling woodland caribou, and the Stand and Site Guide provides additional forest management direction for forest-dwelling species at risk in the boreal landscape (see also section 1.4.4 of this guide). The coarse filter management approach promoted by the Landscape Guide will help to create a natural landscape pattern and a natural landscape composition to help sustain all species, including species at risk, over the long term.

### 2.2.2 The Coarse and Fine Filter Management Approach

There are hundreds of species of vertebrates in the boreal and Great Lakes-St. Lawrence (GLSL) forest regions of Ontario (see D'Eon and Watt 1994, Bellhouse and Naylor 1997) and invertebrate species are likely to number in the tens of thousands. Thus, a species-by-species approach to the provision of wildlife habitat and the conservation of biodiversity is impossible. However, this might be achieved through the hierarchical application of standards and guides that are judiciously selected to act as coarse and fine filters.

The concept of coarse and fine filters was popularized by Hunter (1990) and is illustrated in Figure 3. To manage Ontario's forests to reflect society's ecological, social and economic expectations, Ontario has, over the last fifteen years, begun to rely on a nested coarse and fine filter approach to meet wildlife habitat needs and provide healthy forests (see OMNR 1998a, 1998b, 2001). This forest management guide builds upon this approach. The coarse filter component creates a diversity of ecosystem conditions through space and time, in turn providing habitat for the majority of native species. A series of fine filters is then used, if necessary, to modify the results of applying the coarse filter. A fine filter may be required for one of two reasons: 1) the societal and/or economic aspects of sustainable development require more or less habitat than would be provided by nature, or 2) the ecological requirements of a particular species or value are not addressed or accommodated sufficiently through application of only the coarse filter, in some cases because the proposed actions cannot completely mimic natural events. The extent to which the first type of fine filter is applied will vary across the province, depending on local forest conditions and societal expectations. Both the coarse and fine filters can be applied at all scales, from the landscape to the site.

In designing a coarse filter, one must determine the most desirable mix of ecosystem conditions to include. One of the principles of the CFSA provides direction on what to consider as the coarse filter (i.e. a mix based on nature), as well as what fine filters to develop.

> *The long term health and vigour of Crown forests should be provided for by using forest practices that, within the limits of silvicultural requirements, emulate natural disturbances and landscape patterns* [coarse filter] *while minimizing adverse effects on plant life, animal life, water, soil, air and social and economic values, including recreational values and heritage values* [potential fine filters]. (CFSA s. 2(3)2)

In Ontario, the emulation of natural disturbances and landscape patterns is used as the basis of the coarse filter. The many values that a forest provides, as identified in this principle (e.g. plant life, animal life, water, soil, etc.), and that are particularly sensitive to disturbances caused by management are the topics of a series of fine filters.

Natural disturbances such as wildfire, wind, and insect outbreaks play a role in the development and shaping of the boreal forest landscape. In the Landscape Guide, Ontario's forest landscape is designed through application of the coarse filter by addressing three key prescriptive indicators: pattern, composition and structure. At this scale only a few fine filters are applied to provide for or evaluate the landscape scale habitat requirements of one or more of caribou, white-tailed deer, moose, marten, and pileated woodpecker.

The coarse and fine filter approach to wildlife habitat management has existed for some time and has gradually been introduced and at least partially implemented in most parts of Ontario. It is, however, quite different from the featured species approach used extensively in the past and will take some time before forest planners and operators are familiar with it and understand it fully.

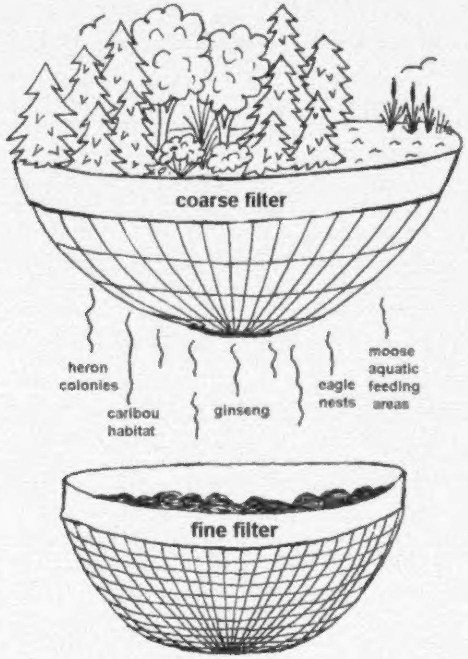


**Figure 3. A conceptual model showing the relationship between coarse and fine filters in habitat management. A coarse filter operates at a variety of spatial scales to: provide habitat for a very broad range of wildlife, to support interactions among wildlife species, and to facilitate ecosystem processes. A fine filter may be required for wildlife species whose needs are not captured by the coarse filter (for example, heron nests and moose aquatic feeding areas). Biodiversity is most likely to be conserved by hierarchical application of both filters on the landscape (figure courtesy of Kandyd Szuba).**

### 2.2.3 Comparison of Featured Wildlife Species Guidelines to Coarse Filter Direction

Previous forest management guides directed management to provide habitat for featured wildlife species. Landscape composition, structure and pattern direction addresses habitat for a range of wildlife – including those wildlife species featured in previous habitat management guides. A coarse filter that emulates natural disturbances and landscape patterns should provide an adequate amount of habitat in general across the landscape. This includes landscape-level featured wildlife species habitat needs, such as interspersed age classes of conifer and mixed forest for moose and deer, or larger patches of mature conifer dominated or mixedwood forest for marten and pileated woodpecker.

Table 1 relates landscape level direction in previous featured wildlife species guides (excluding woodland caribou, since it is treated as a fine filter in this guide) to comparable coarse filter direction that forms the basis of the *replacement* landscape direction (section 3). For example, the 500 ha scale of measure for the texture of the mature and old forest indicator used in the Landscape Guide is similar to the 500 ha home range for marten. These results suggest provision of marten habitat through the use of a coarse filter that emulates the landscape patterns, specifically the amount and distribution of mature forest that would have resulted from natural disturbances. These results have also been incorporated into a new habitat model for marten (see Science Package A for details). All of the wildlife species discussed below have spatial habitat models included in OLT. Stand and site level direction from these guides has been included in the Stand and Site Guide (OMNR 2010).

**Table 1. Comparison of habitat direction featured in wildlife species guidelines with comparable coarse filter direction.**

| Previous Management Guidelines | | Comparable Landscape Guide direction |
|---|---|---|
| Name | Landscape Level Directions | |
| Timber Management Guidelines for the Provision of Moose Habitat (OMNR 1988) | • Clearcut size and arrangement<br>• Distance to cover | • Young Forest Patch Size<br>• Texture of the mature and old forest |
| Forest Management Guidelines for the Provision of White-tailed Deer Habitat (OMNR 1997) | • Forage and thermal cover that is arranged together in winter concentration areas known as deer yards | • Area of mature landscape class<br>• Young Forest Patch Size |
| Forest Management Guide for the Provision of Marten Habitat (OMNR 1996a) | • Supply and arrangement of mature and older conifer-dominated forest (used and preferred habitat) across the boreal landscape | • Texture of the mature and old forest<br>• Area of mature conifer-dominated landscape class |
| Forest Management Guide for the Provision of Pileated Woodpecker Habitat (OMNR 1996b) | • Supply and arrangement of mature and older forest (used and preferred habitat) across the GLSL landscape | • Texture of the mature and old forest<br>• Area of mature landscape classes |

## *2.3 Understanding Ranges of Natural Variation*

The relationship between biodiversity measured at the landscape scale and ecological processes that result in natural disturbance patterns has been described as an adaptive cycle (Gunderson and Holling 2001). One example of an adaptive cycle is the progress of a possible cycle for an ecological system in which stand-replacing fires are a disturbance agent (Figure 4). In this example, forested landscapes develop as a mixture of tree species which became established in a *reorganization* phase of the adaptive cycle after disturbance and further develop along a trajectory during the *growth, maturity* and *collapse* phases. Perera *et al.* (2004) provide a thorough review of concepts and applications in emulating natural disturbance. Management strategies designed to conserve biodiversity must ensure that, at a landscape scale, future forest conditions contain all phases of the adaptive cycle in order to maintain the ecological processes that service all values. The Landscape Guide recognizes the importance of maintaining this dynamic by directing forest management to create and/or maintain the landscape mosaic created by and driving this adaptive cycle. Forest management seeks to *emulate*, not *mimic*, different phases of the adaptive cycle, primarily through the silvicultural intervention required to create future forest conditions. Our understanding and quantification of the adaptive cycles of naturally disturbed landscapes and how these landscapes provide ecological functions is one of the main uncertainties in evaluating the effectiveness of the Landscape Guide. These uncertainties are addressed in more detail in section 4.1.

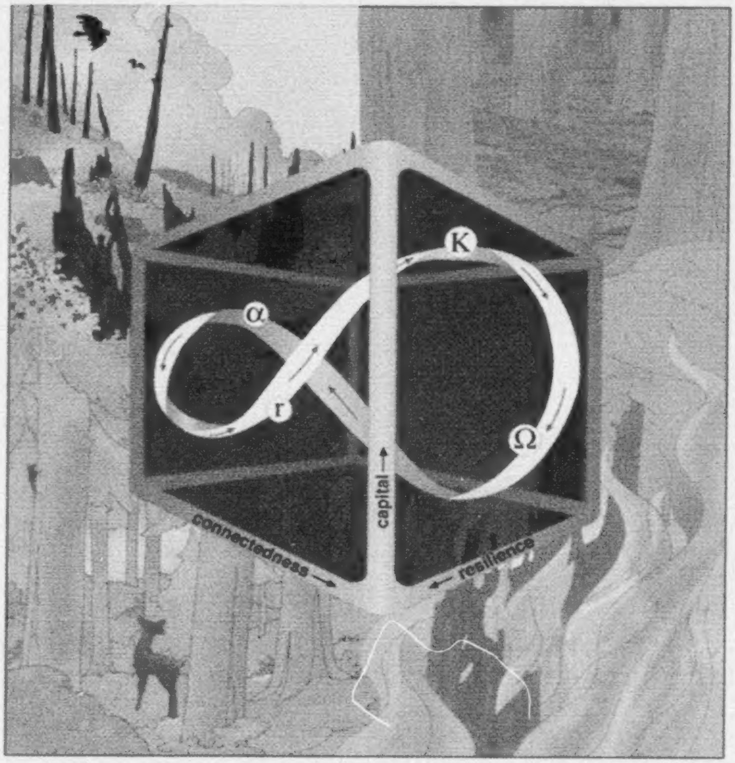


**Figure 4. A schematic illustration of an adaptive cycle in a forest landscape (from Bunnel 2003). It shows that forest ecosystems are dynamic and can be thought of as following an adaptive cycle that has four phases: growth (r) , maturity (K), collapse (Ω) and reorganization (ά).**

Quantitative estimates of the landscape structure, composition and pattern that might arise from natural disturbances and landscape patterns are required to provide Landscape Guide direction. There are three sources of information that were used to make these estimates for the Landscape Guide:

1. The Pre-Industrial Condition (PIC) provides estimates what happened at a specific point or period in time. The Landscape Guide uses PIC information from Ontario Lands Survey Notes (Elkie 2013b) to estimate landscape structure, composition and pattern across the Landscape Guide regions. The strength of this information is that it provides estimates of landscape condition (structure and composition) that at one time existed and consequently can be used to assist in validating simulation models. On the other hand, a PIC-based estimate only tells you about a single landscape that resulted from specific combinations of ecological, climate and disturbance events at the time the surveys were performed. Generally, PICs have less information about forest age.
2. The current forest condition provides the most accurate estimate of landscape structure, composition and pattern. Forest Resource Inventory (FRI) maps are used by the Landscape Guide to produce these estimates. The Landscape Guide recognizes that parts of the boreal forest landscape have been managed for up to 100 years and that these estimates of the current landscape condition provide a reference point that informs us more of the result of this management than a landscape that has been naturally disturbed.
3. Landscape simulation models can be used to provide probability-based estimates about what might happen over a specific period in time. The Landscape Guide uses landscape disturbance and succession models to simulate the adaptive cycles of landscapes as they might occur without human intervention. The boreal science teams estimated simulated ranges of natural variation (SRNV) for landscape composition and pattern using the Boreal Forest Landscape Disturbance Simulator (BFOLDS) (OMNR 2008). A critical and iterative process of developing BFOLDS model inputs including forest disturbance and succession rules was carried out by the science team. The goal of this process was to simulate natural variation around natural reference condition that was similar to a pre-industrial condition (PIC). Iterations involved modifications by the science team and field practitioners to the BFOLDS model inputs. These inputs included landscape dynamics, (e.g. forest succession rules and disturbance sizes and cycles) landscape condition (e.g. forest cover and age) and model mechanics (e.g. how the BFOLDS simulated fire spread). Iterations continued until the PIC forest composition and amounts of disturbance was simulated by BFOLDS or could be reconciled by model limitations in representing natural processes (Figure 5). For more information and examples of these iterations, refer to Science Package A: Simulations, Rationale and Inputs (Elkie *et al.* 2013b).

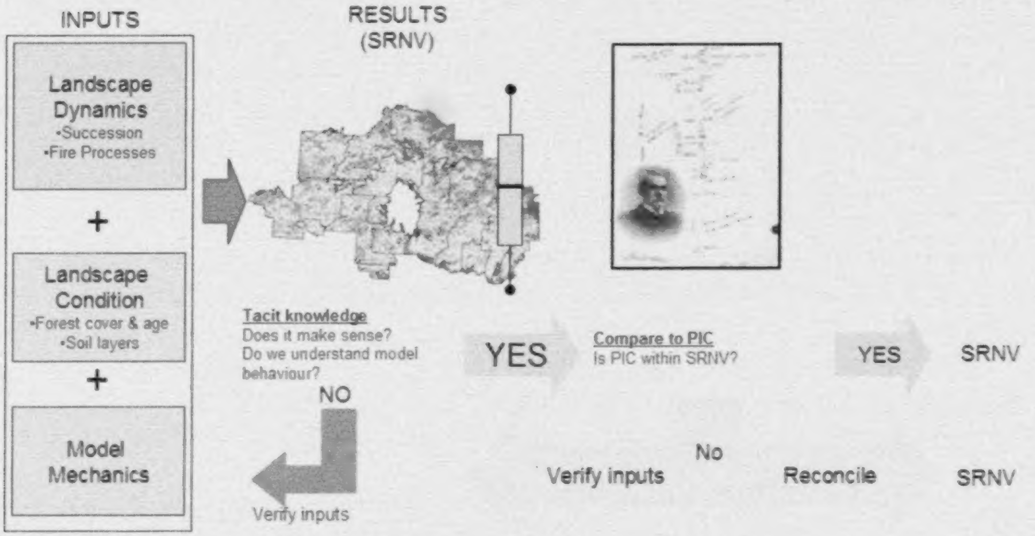


**Figure 5. A decision tree showing modelling iterations involving modifications by the science team and field practitioners to the BFOLDS model inputs. These inputs included landscape dynamics, (e.g. forest succession rules and disturbance sizes and cycles) landscape condition (e.g. forest cover and age) and model mechanics (e.g. how the BFOLDS simulated fire spread). Iterations continued until the PIC was simulated by BFOLDS**

BFOLDS was calibrated and simulations run for each Boreal Landscape Guide region. The calibration included developing model inputs that represented ecological processes such as flammability, succession, weather, etc. BFOLDS was run for an initialization period in which natural disturbances and succession were simulated to “erase” the existing human/management footprint. After this initialization period, the SRNVs were estimated by taking measurements of landscape indicator values at simulation years 100, 150 and 200. The SRNVs are presented as a box and whisker plot for non-spatial indicators and as a frequency histogram for spatial/pattern indicators (Figure 6). The SRNVs were estimated using the entire Landscape Guide Region land base and individual forest management unit SRNVs were extracted from these simulation surfaces to allow for integration into forest management planning. A draft set of SRNVs were reviewed by practitioners in each Landscape Guide region and model revisions were made based on these reviews.

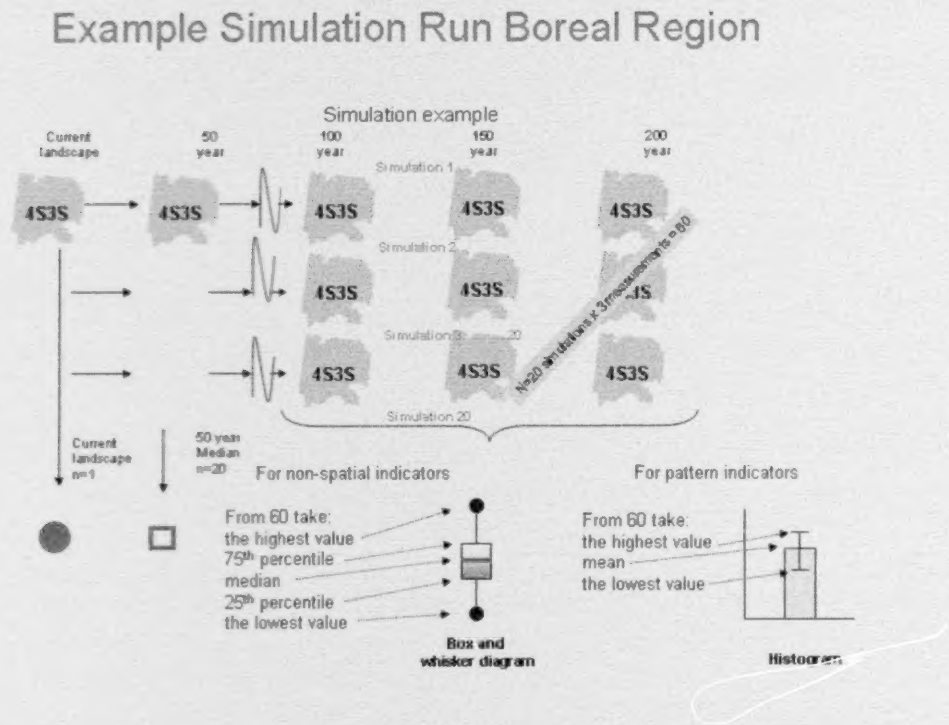


**Figure 6. Example simulation information sheet. The SRNV was calculated by taking measurements of landscape indicator values at 50 year intervals (i.e., years 100, 150 and 200). The resulting SRNVs are expressed as box and whisker plots for non-spatial (i.e., amount) indicators or as a histogram for spatial/pattern indicators.**

There are several supporting electronic documents that accompany the Landscape Guide (available for download at: www.olt.tbayteldirectit.com):

- **Science and Information in support of Ontario's Forest Management Guides for Landscapes: Science Package – Series A: Simulations, Rationale and Inputs. Version 2013** (herein called Science Package A): This document provides the rationale and methodology of simulation modeling that was used to simulate ranges of natural variation. It provides a detailed description of all models and inputs (e.g. disturbance regimes and succession pathways) (Elkie *et al.* 2013b)

- **Science and Information in support of Ontario's Forest Management Guides for Landscapes: Science Package - Series B: Results: Landscape Guide Region 3E** (Elkie *et al.* 2013c)

- **Science and Information in support of Ontario's Forest Management Guides for Landscapes: Science Package - Series B: Results: Landscape Guide Region 3W** (Elkie *et al.* 2013d)

- **Science and Information in support of Ontario's Forest Management Guides for Landscapes: Science Package - Series B: Results: Landscape Guide Region 3S/4S** (Elkie *et al.* 2013e)

- **Science and Information in support of Ontario's Forest Management Guides for Landscapes: Science Package - Series B: Results: Landscape Guide Region 4W** (Elkie *et al.* 2013f)

- **Science and Information in support of Policies that address the Conservation of Woodland Caribou in Ontario: Occupancy, Habitat and Disturbance Models, Estimates of Natural Variation and Range Level Summaries. Electronic Document. Version 2013** (Elkie *et al.* 2013g)

- **Science and Information in support of Policies that address Landscape Level Moose Requirements: Science Package - Series B, Habitat Definitions, Models and Simulation Results** (Elkie *et al.* 2013h)

The last six electronic documents include results and tools for ***Landscape Guide*** implementation in forest management planning. In addition, historic information from Ontario Land Surveys provides an estimate of the pre-industrial condition of the forest (PIC).

Multiple information sources were used during the development of estimates since it is unlikely that any single source of information will provide enough insight to estimate ranges of natural variation for all indicators. OLT and the science packages provide complete descriptions of information sources including the SRNV, historical survey records (Pre-Industrial Condition), and current ecological databases (e.g. FRI, remote sensing, growth and yield plots). Additional science and information can be used in application of the Landscape Guide with the approval of OMNR forest science and regional planning specialists (***best management practice***).

### 2.3.1 Climate Change and the Landscape Guide

Climate change may impact biological diversity in many ways by changing patterns of insect and disease outbreaks, plant and animal distributions and natural disturbance events (OMNR 2005). Climate change projections for Ontario (Colombo 2008) allow policymakers in Ontario to envision the potential impacts of climate change on people, infrastructure and the environment. Recent ecological literature proposes policy-level strategies for climate change mitigation and adaptation (e.g. Chapin et al. 2006, Spittlehouse 2005). At a management unit level, sustainable forest management that maintains or increases forest carbon stocks and produces an annual sustained yield of timber, fibre, or energy from the forest, provides the largest sustained mitigation of climate change ((Ter-Mikaelian et al. 2008, IPCC 2007), while also providing many social and environmental benefits (IPCC 2007). The Landscape Guide directs sustainable forest management to maintain a natural range of tree species mixes, ages, and patch sizes with an assumption that this variation will enable forest ecosystems to be resilient (i.e. having the capacity to adapt) to changes in temperature and precipitation. Following landscape direction to manage a forest's age and tree species composition within a range of natural variation will maintain the above ground forest's carbon balance within an expected range of natural variation (Colombo *et al.* 2005). In addition, the Landscape Guide must, by law, be reviewed every five years and revised when appropriate to reflect new knowledge and experience. As our understanding and predictions about climate change improve, policy options that more actively respond to climate change may be incorporated into future versions of the Landscape Guide to address its effects more directly.

### 2.4 *Evaluating Alternative Management Options*

The science team created strategic forest management simulations using the Patchworks model in order to forecast outcomes of the two management options: the featured wildlife species approach used in previous forest management guides and the coarse and fine filter approach of the Landscape Guide.

Management options were created at two management scales: single forest management units and the landscape guide region 3W. Forecasting allowed different management scenarios to be generated for either management option. At the management unit level, for example, in the technical report "Forest Policy Scenario Analysis: Evaluating the Effectiveness of Coarse-Filter Policy Options on Conserving Forest Songbird Communities" a quantitative ranking was given to each alternative set of forest management policy options. The options were evaluated in terms of how close the songbird community responded to forests arising from various option-sets (scenarios) relative to the simulated natural forest. This ranking provided input into the overall decision making process, specifically the development of Landscape Guide indicators. These alternative forecasts were evaluated against the SRNV, economic and social indicators. The economic indicators included medium and long term harvest volume by tree species group, transportation and silvicultural costs. Social, non-timber indicators were habitat for featured wildlife species and old growth. Explicit acceptable levels of tolerance for effects of management simulations on social and economic values *were not* generated in the development of this guide. Relative impacts, however, were assessed through Landscape Guide region workshops through the comparison of possible management scenarios. The development and science teams used these models to assess combinations of potential standards and guidelines as ways to meet selected management objectives of each option. The results of these analyses were presented to various groups in Landscape Guide regions listed in section 0 and are available from Forest Policy Section, Ontario Ministry of Natural Resources.

#### 2.4.1 Developing Milestones

Through an iterative process of scenario development described above, a possible management trajectory towards or within Landscape Guide ranges was developed for each forest management unit.

The modeling techniques used in estimating the SRNV in the development of this guide are different than those that were used in the development of the Great Lakes-St. Lawrence Landscape Guide. As a result, the estimates of the SRNV for the boreal forest incorporate a much wider range of conditions including extreme years where a significant portion of the landscape burned. In several instances, the minimum amount of the SRNV approached zero. The science and regional planning teams felt that using the full range of the SRNV and incorporating extreme estimates (i.e., using the minimum) would pose significant risk in the context of ecological integrity. In other words, using the extremes would create landscapes that would be on the edge of the ecological thresholds and consequently be vulnerable to climate change, insect infestation, increases in fire intensity and amount, etc. Therefore the interquartile ranges (IQR), the middle 50 percent of SRNV values, are being used as desirable levels in this guide, compared to the entire SRNV used in the Great Lakes-St. Lawrence volume.

Milestones were developed to describe this trajectory for each management unit and for each Landscape Guide indicator. They include directional statements (e.g. maintain, increase or decrease) from the present condition over the short (0-10 years), medium (0-20 years) and long term (0-100 years). Planning teams will use these directional statements when developing specific targets for Landscape Guide indicators (see section 3.4). The forest management planning manual considers silviculture, economic and several social objectives when developing a forest management plan and consequently milestones were developed to provide a time frame (short, medium or long term) which focused mostly on the achievement of biodiversity objectives.

These general steps were followed in each Landscape Guide region to develop milestones:

1. Draft SRNVs were presented at workshops attended by representatives of forest management planning teams.
2. Revisions to landscape simulation model inputs were made based on input from workshop participants following the same decision-making process described in section 2.4 (e.g. changes to forest succession rules). A final SRNV was estimated and/or additional information added to PIC and incorporated into OLT.
3. A range of management scenarios to maintain or move the landscape towards the SRNV was explored through an iterative process that did a rough screening of socio-economic and silvicultural considerations to select a scenario according to these development principles:
    - Landscape guide direction, together with forest management planning, supports CFSA principles of sustainability.
    - Consider current landscape conditions, silvicultural limitations, and effects on other values (for example, provincially featured wildlife species), not to take precedence over biodiversity conservation, but rather identified realistic management opportunities.
    - Differences between the current condition of the landscape and the SRNV may be the result of management actions that occurred long before the era of forest sustainability (white pine logging in the late 1800's) and/or may be the result of pests or pathogens (e.g. white pine blister rust).
4. Milestones were presented directly to the Provincial Forest Technical and Regional Advisory Committees, and to the public through posting of the Landscape Guide on the Environmental Registry.
5. Milestones, by management unit, for each Landscape Guide indicator can be found in the appendices of the Landscape Guide.

### 2.4.2 Pilot Testing the Landscape Guide

Pilot testing was part of the development of the Landscape Guide. Pilot testing dealt with evaluating the efficiency of implementing the Landscape Guide, and identifying and correcting problems in draft direction. A pilot test in which actual application of the Landscape Guide to a forest management plan was not considered since this would have required preparation of a separate forest management plan. The Landscape Guide directs strategic forest management planning and so the development team sought the advice of experienced forest management planning professionals in the writing of the guide and development of direction. The development of milestones allowed for further refinement of guide direction and implementation steps through discussions with foresters and biologists. Pilot testing of the science and information products was conducted primarily by providing them to 2010 forest management planning teams for use as background information in the development of their forest management plans. In addition, OLT was subjected to two phases of beta-testing; within OMNR and with non-government forest managers.

## 3 Applying the Landscape Guide in a Forest Management Plan

The following points summarize the application of the Landscape Guide in Phase I of a forest management plan:

1. Measure the current forest condition using Landscape Guide indicators (see section 3.1).
2. Use the inter-quartile-range (IQR) of the SRNV as the forest management plan desirable levels for area based indicators and the mean SRNV of texture classes for pattern based indicators (see section 3.3).
3. Develop targets for the Landscape Guide indicators that are consistent with movement within or towards the IQR (see section 3.4).
4. Identify large landscape patches (LLPs) when required to meet targets for landscape pattern or habitat indicators (see section 3.5).

### *3.1 Measure the Condition of the Current Forest Landscape*

The Landscape Guide indicators quantify landscape structure, composition and pattern as an efficient set of tools to direct management. The Landscape Guide indicators are variables that are used to describe the current landscape mosaic, make predictions on the future landscape mosaic and assist in evaluating the effectiveness of the Landscape Guide. Indicators were selected by compiling and categorizing previous landscape-level direction and then comparing them to simulations of forest management landscapes. For example, the science team assigned a quantitative ranking to each alternative set of forest management policy options. The options were evaluated in terms of how close the songbird community responded to forests arising from various option-sets (scenarios) relative to the simulated natural forest (Rempel *et al.* 2007). This ranking was used by the development team to select a parsimonious set of Landscape Guide indicators to direct the landscape composition, structure and pattern. The Landscape Guide indicators are listed in Table 2 and Table 3.

FMP Application

***Forest management plans will use the Landscape Guide indicators as the biodiversity indicators of objective achievement. The indicators required in FMPs can vary by Landscape Guide region as listed in the Landscape Guide Appendices (for example the landscape classes). Landscape Guide indicators will replace previous forest management planning direction for landscape pattern, area by forest type and age and amount and distribution of old growth forest (standard).***

The forest management planning team can use OLT to analyze and document their planning inventory to calculate plan start levels for all of the Landscape Guide indicators in table FMP-9[1] ***(best management practice)***.

Planning teams should apply Landscape Guide indicators in the order recommended in Table 2 (Northwest Region) and Table 3 (Northeast Region) ***(best management practice)***. The order of this hierarchy is based on experience from the development of the Landscape Guide and recognizes that pattern is dependent on composition. For example it is difficult to arrange the texture of the mature and old forest if the amount does not exist on the landscape. Teams can follow this order through all subsequent application steps in this section.

---

[1] Or in the applicable documentation table for objective achievement described in the forest management planning manual.

Several indicators (e.g. all age conifer, caribou habitat, etc.) differ between the Northeast and Northwest Regions. These differences are attributed to a number of variables including ecological regions, caribou landscape use, landforms, climate etc. Caribou habitat classifications in the Northwest Region include two models, refuge and winter habitat, termed the conventional boreal model. In contrast, in the claybelt portion of the Northeast Region the habitat models include suitable and mature conifer, termed the claybelt boreal model. The details of these differences are described in Science and Information Package "C"aribou (Elkie *et al.*, 2013g) and are reflected in the Tables 2 and 3.

**Table 2. Landscape Guide Indicators for Landscape Guide Regions 3S4S, 4W and 3W, arranged by CFSA category, Landscape Guide section heading, indicator name, recommended order of application and units of measurement. Caribou habitat indicator is only applied in forest management units that are fully within or intersect caribou population ranges as identified in the Caribou Conservation Plan. Refer to section 3.1 for specific details on Landscape Guide indicators.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Recommended order of application | Measurement (units) |
|---|---|---|---|---|
| Caribou Habitat | Habitat Amount | Refuge habitat | 1st | Area (ha) |
| | | Winter habitat | | Area (ha) |
| | Habitat arrangement and connectivity | Texture of woodland caribou refuge habitat | | Proportion in the >=60% texture classes(6,000 and 30,000 ha) |
| | | Texture of woodland caribou winter habitat | | Proportion in the >=60% texture classes(6,000 and 30,000 ha) |
| Structure and Composition | Landscape classes (mature and older age classes) | Balsam fir and balsam fir mixedwoods | 2nd | Area (ha) |
| | | Lowland conifer | | Area (ha) |
| | | Upland conifer and conifer mixedwoods | | Area (ha) |
| | | Hardwoods and hardwood mixedwoods | | Area (ha) |
| | Old growth forest | Old growth by Forest Management Plan Forest Unit or appropriate grouping | 3rd | Area (ha) |
| | Forest unit groupings | Red and white pine forest units | 5th | Area (ha) |
| | | Spruce and pine-dominated forest units | 6th | Area (ha) |
| | Young forest < 36 years | Young forest < 36 years | 7th | Area (ha) |
| Pattern | Texture of the mature and old forest | Texture of the mature and old forest | 4th | 500 ha hexagon histogram |
| | | | | 5000 ha hexagon histogram |
| | Young forest patch size | Young forest patch size | 8th | Patch size frequency histogram |

**Table 3. Landscape Guide Indicators for Landscape Guide Region 3E arranged by CFSA category, Landscape Guide section heading, indicator name, recommended order of application and units of measurement. Caribou habitat indicator is only applied in forest management units that are fully within or intersect caribou population ranges as identified in the Caribou Conservation Plan. Refer to section 3.1 for specific details on Landscape Guide indicators.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Recommended order of application | Measurement (units) |
|---|---|---|---|---|
| Caribou Habitat | Habitat Amount | Winter suitable habitat | 1st | Area (ha) |
| | | Mature conifer habitat | | Area (ha) |
| | Habitat arrangement and connectivity | Texture of woodland caribou winter suitable habitat | | Proportion in the >=75% texture classes (6,000 and 30,000 ha) |
| | | Texture of woodland caribou mature conifer habitat | | Proportion in the >=28% texture classes (6,000 and 30,000 ha) |
| Structure and Composition | Landscape classes | Immature and older pine | 2nd | Area (ha) |
| | | Mature and older upland conifer | | Area (ha) |
| | | Immature and older hardwood and immature mixedwood | | Area (ha) |
| | | Mature and older mixedwood | | Area (ha) |
| | | Mature and older lowland conifer | | Area (ha) |
| | Old growth forest | Old growth by Forest Management Plan Forest Unit or appropriate grouping | 3rd | Area (ha) |
| | Forest unit groupings | All ages red and white pine forest units | 5th | Area (ha) |
| | | All ages spruce and pine-dominated forest units | 6th | Area (ha) |
| | Young forest < 36 years | Young forest < 36 years | 7th | Area (ha) |
| Pattern | Texture of the mature and old forest | Texture of the mature and old forest | 4th | 500 ha hexagon histogram |
| | | | | 5000 ha hexagon histogram |
| | Young forest patch size | Young forest patch size | 8th | Patch size frequency histogram |

### 3.1.1 Structure and Composition

The majority of landscapes for which this guide is applicable have remained continuously forested. However, forest harvesting, coupled with fire suppression have altered landscape structure and composition across Ontario compared to naturally disturbed landscapes (Aird 1985, Hearndon et al 1992). Comparisons of historic with current forest conditions across the landscape show reductions and increases in some tree species due to forest harvest, land settlement, human caused fires and other activities. For example, in a comparison of historic survey notes and current forest inventory, Elkie (informal report) found that boreal forests in northwestern Ontario currently contain more mixedwood forest than was found in the late 1800s. Pinto and Romaniuk (2002) also compared land surveyor notes in the Temagami region of Ontario and found a decrease in conifer dominated forest cover and an increase in intolerant and mid-to-tolerant hardwood forest. Comparing historic conditions of Algonquin Park to the present, Quinn (2004) found a similar loss of conifer, alteration in gap size structure, qualitative change in woody debris, a reduction in basal area and of "supersize" trees, and a reduction in early successional riparian (beaver) habitat. However, he emphasized that these changes are not fundamental; the forest ecosystem is substantively similar to the past.

The current forest age class structure and tree species composition of the landscape are two of the strongest drivers of the future forest landscape condition, and are likely to influence future forest condition as strongly as management activities. For example, according to the forest inventory, Ontario's forests currently have a bimodal age-class distribution, with large amounts of young and old forest, and are increasing in age (OMNR 2002). The ecological literature discusses varying effects of fire suppression on the composition and age-class structure of the forest (e.g. Johnson *et al.* 2001, Podur *et al.* 2002). Carleton and MacLellan (1994) compared upland post-fire to upland post-logging stands and found that the logged stands were less likely to have returned to their original composition than if they had burned. Suffling *et al.* (1982) concluded that younger age classes represented a much higher proportion of the landscape prior to fire suppression in NW Ontario. Carleton (2000) provides a more detailed discussion of vegetation responses to the managed forest landscapes of central and northern Ontario.

The literature varies in its use of the terms "forest structure" and "composition". For purposes of this guide, landscape structure indicators consider forest structure to be a combination of development stage (e.g. sapling, immature, mature) and canopy structure (even or uneven aged). Composition is measured at the landscape level by classifying forest stands into forest units and aged-based development stages. The forest units are based on a classification system that aggregates forest stands for management purposes, combining those that will normally have similar tree species composition, will develop in a similar manner (both naturally and in response to silvicultural treatments), and will be managed under the same silviculture system. The forest unit currency is the base unit used for simulations in each Landscape Guide region for all results (e.g. landscape classes, evaluative indicators etc). The forest units used were the OMNR regional standard forest units available at the time of running the simulations. The Landscape Guide structure and composition indicators are described in detail in the sections below.

FMP Application
***Planning teams will include all crown land within the forest management unit when measuring landscape structure and composition indicators (standard).***

**Table 4. Forest units, development stages and landscape classes used in the Boreal West Forest Region. Each forest unit has a name, description, ages of onset of development stages with a colour coding indicating the corresponding landscape class for the forest unit development stage.**

| NW Forest Unit | Development Stage (Landscape Class) | | | | |
|---|---|---|---|---|---|
| | Presapling | Sapling | Immature | Mature | Late |
| BfDom | 0 (PS) | 5 (PS) | 10 (IC) | 60 (MLBF) | 80 (MLBF) |
| BwDom | 0 (PS) | 5 (PS) | 10 (IH) | 50 (MLHM) | 110 (MLHM) |
| ConMX | 0 (PS) | 10 (PS) | 30 (IC) | 70 (MLUCM) | 110 (MLUCM) |
| HrdMw | 0 (PS) | 5 (PS) | 10 (IH) | 60 (MLHM) | 110 (MLHM) |
| HrDom | 0 (PS) | 5 (PS) | 10 (IH) | 60 (MLHM) | 100 (MLHM) |
| OcLow | 0 (PS) | 10 (PS) | 30 (IC) | 70 (MLLC) | 120 (MLLC) |
| OthHd | 0 (PS) | 5 (PS) | 10 (IH) | 60 (MLHM) | 100 (MLHM) |
| PjDom | 0 (PS) | 10 (PS) | 30 (IC) | 70 (MLUCM) | 100 (MLUCM) |
| PjMx1 | 0 (PS) | 10 (PS) | 30 (IC) | 70 (MLUCM) | 100 (MLUCM) |
| PoDom | 0 (PS) | 5 (PS) | 10 (IH) | 60 (MLHM) | 100 (MLHM) |
| PrwMx | 0 (PS) | 10 (PS) | 20 (IC) | 80 (MLUCM) | 140 (MLUCM) |
| SbDom | 0 (PS) | 10 (PS) | 30 (IC) | 70 (MLUCM) | 120 (MLUCM) |
| SbLow | 0 (PS) | 10 (PS) | 30 (IC) | 70 (MLLC) | 160 (MLLC) |
| SbMx1 | 0 (PS) | 10 (PS) | 30 (IC) | 70 (MLUCM) | 110 (MLUCM) |

Landscape Class Legend
PS – Pre-sapling and sapling, IC – Immature Conifer, IH – Immature hardwood,
MLBF – Mature and late balsam fir, MLLC – Mature and late lowland conifer,
MLHM – Mature and late hardwood & mixed, MLUCM – Mature & late upland conifer & mixed.

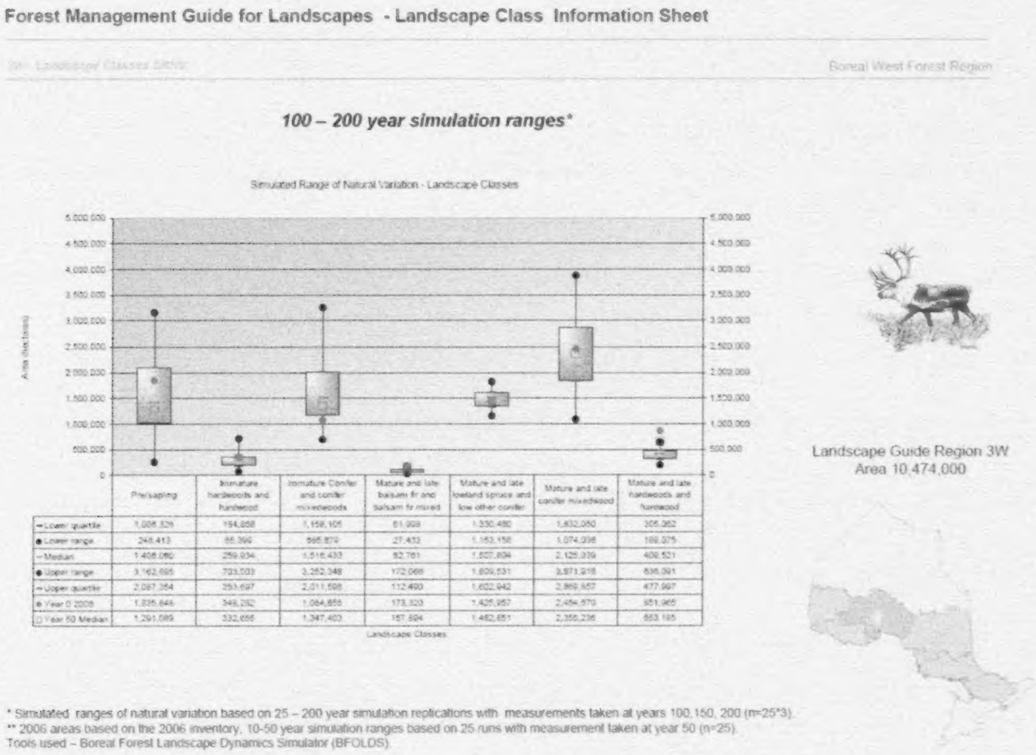
**Table 5. Forest units, development stages and landscape classes used in the Boreal East Forest Region. Each forest unit has a name, description, ages of onset of development stages with a colour coding indicating the corresponding landscape class for the forest unit development stage.**

| NE Forest Unit | Development Stage (Landscape Class) | | | | |
|---|---|---|---|---|---|
| | Presapling | Sapling | Immature | Mature | Late |
| PR1 | 0 (P) | 15 (S) | 40 (IOP) | 80 (IOP) | 130 (IOP) |
| PRW | 0 (P) | 15 (S) | 40 (IC) | 80 (MOM) | 130 (MOM) |
| LH1 | 0 (P) | 10 (S) | 30 (IOHIM) | 70 (IOHIM) | 100 (IOHIM) |
| SB1 | 0 (P) | 20 (S) | 40 (IC) | 80 (MOLC) | 120 (MOLC) |
| PJ1 | 0 (P) | 10 (S) | 30 (IOP) | 70 (IOP) | 110 (IOP) |
| LC1 | 0 (P) | 20 (S) | 40 (IC) | 80 (MOLC) | 120 (MOLC) |
| PJ2 | 0 (P) | 10 (S) | 30 (IC) | 70 (MOC) | 110 (MOC) |
| SP1 | 0 (P) | 15 (S) | 40 (IC) | 80 (MOC) | 110 (MOC) |
| SF1 | 0 (P) | 15 (S) | 40 (IC) | 80 (MOC) | 110 (MOC) |
| PO1 | 0 (P) | 10 (S) | 30 (IOHIM) | 60 (IOHIM) | 90 (IOHIM) |
| BW1 | 0 (P) | 10 (S) | 30 (IOHIM) | 60 (IOHIM) | 90 (IOHIM) |
| MW1 | 0 (P) | 10 (S) | 30 (IOHIM) | 70 (MOM) | 100 (MOM) |
| MW2 | 0 (P) | 10 (S) | 30 (IOHIM) | 70 (MOM) | 100 (MOM) |
| MW3 | 0 (P) | 10 (S) | 30 (IOHIM) | 70 (MOM) | 100 (MOM) |

Landscape Class Legend
P – Pre-sapling, S – Sapling, IOP – Immature and older pine, IC – Immature conifer, IOHIM – Immature and older hardwood and immature mixedwood, MOM – Mature and older mixedwood, MOC – Mature and older conifer, IOP – Immature and older pine, MOLC – Mature and older lowland conifer.

### 3.1.1.1 Landscape Classes

Landscapes provide habitat for many wildlife species, each with its own preferences for combinations of vegetation types, development stages, patch sizes and configurations. As discussed earlier, it would be difficult to manage wildlife habitat with a species-by-species approach within the context of a forest management plan. To reduce the complexity of this problem, the landscape development team suggested the development of landscape classes according to our understanding of how forests function as habitat. They requested a classification scheme of between 5-10 classes for easy visual interpretation. The landscape classes are the fundamental coarse filter assessment units. Landscape classes are groupings of forest units by development stage. They were developed based on cluster analyses of used and preferred habitat types depicted in OMNR's habitat matrices (e.g., Holloway *et al.* 2004). The habitat matrices summarize habitat affinities of selected vertebrate species based on forest type and development stage. The landscape classes express meaningful differences in wildlife use. The SRNV of the landscape class indicators is presented as a box and whisker graph (Figure 7). The SNRV for the landscape class indicators are provided for each forest management unit in Science and Information Package B.



**Forest Management Guide for Landscapes - Landscape Class Information Sheet**

3W - Landscape Classes SRNV

Boreal West Forest Region

***100 – 200 year simulation ranges****

Simulated Range of Natural Variation - Landscape Classes

| | Presapling | Immature hardwoods and hardwood | Immature Conifer and conifer mixedwoods | Mature and late balsam fir and balsam fir mixed | Mature and late lowland spruce and low other conifer | Mature and late conifer mixedwood | Mature and late hardwoods and hardwood |
|---|---|---|---|---|---|---|---|
| ━ Lower quartile | 1,008,326 | 184,858 | 1,158,105 | 61,999 | 1,330,480 | 1,832,050 | 305,362 |
| ● Lower range | 246,413 | 65,396 | 685,879 | 27,433 | 1,163,156 | 1,074,098 | 169,075 |
| ━ Median | 1,406,080 | 259,934 | 1,516,432 | 82,761 | 1,507,804 | 2,125,039 | 409,521 |
| ● Upper range | 3,162,695 | 703,003 | 3,252,348 | 172,066 | 1,809,531 | 3,871,918 | 836,091 |
| ━ Upper quartile | 2,087,354 | 353,697 | 2,011,598 | 112,490 | 1,602,942 | 2,869,957 | 477,987 |
| ● Year 0 2006 | 1,835,646 | 348,282 | 1,064,856 | 173,320 | 1,425,957 | 2,454,570 | 851,965 |
| □ Year 50 Median | 1,291,089 | 332,656 | 1,347,403 | 157,894 | 1,482,851 | 2,356,236 | 853,185 |

* Simulated ranges of natural variation based on 25 – 200 year simulation replications with measurements taken at years 100,150, 200 (n=25*3).
** 2006 areas based on the 2006 inventory, 10-50 year simulation ranges based on 25 runs with measurement taken at year 50 (n=25).
Tools used – Boreal Forest Landscape Dynamics Simulator (BFOLDS).

**Figure 7. An example SRNV information sheet for landscape class indicators. The SRNV is expressed as a box and whisker plot. Indicator values at year 0 of the modelling period (roughly 2006) shown as green dot. The red square represents the value 50 years into the simulation.**

FMP Application

***Forest management plans will represent landscape classes in strategic forest management models (standard).***

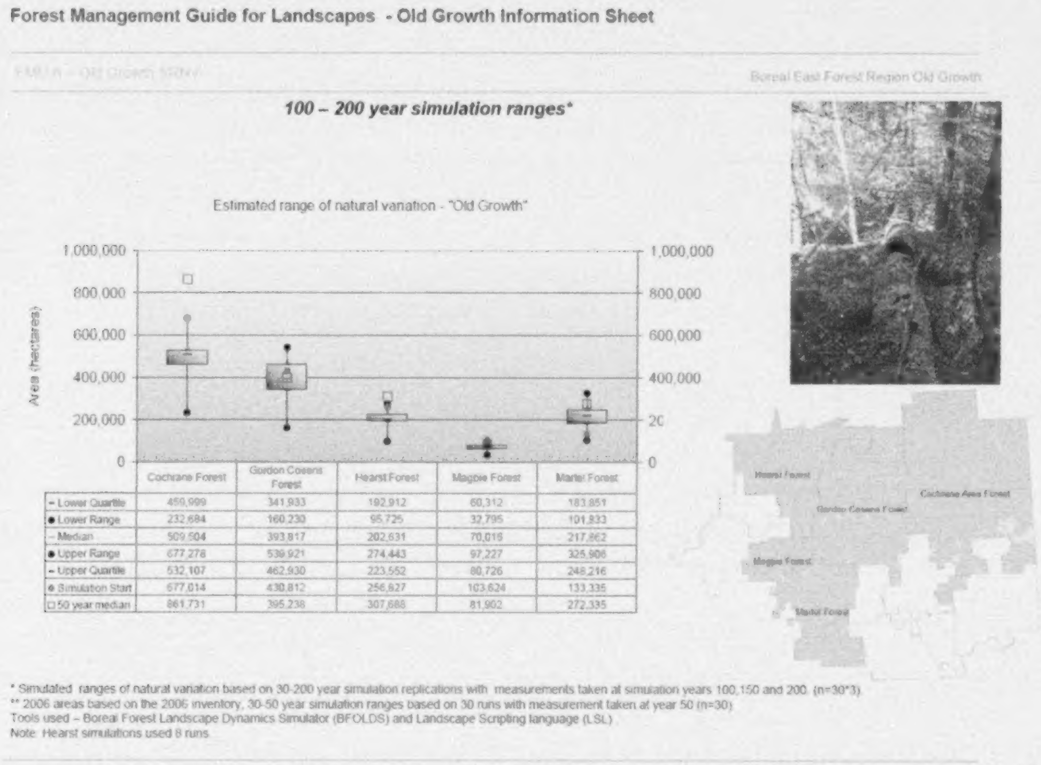
***Planning teams will compare their plan forest units to the Landscape Guide forest units to ensure that there is compatibility at the landscape class level (guideline).*** Detailed FRI query description of forest units used in the development of Landscape Guide forest units are provided in Science and Information Package "A".

### 3.1.1.2 Old Growth Forest

The Old Growth Policy for Ontario's Crown Forests (OMNR 2003) describes how MNR will ensure that old growth conditions and values are present in Ontario's Crown forests in order to conserve biological diversity at levels that maintain or restore ecological processes, while allowing for sustainable development now and in the future. This policy is compatible with the CFSA principle of emulating natural disturbance and landscape patterns (i.e. to manage forests to more closely emulate their natural states and conditions, including old growth), which the Landscape Guide treats as a hypothesis (see section 2.3). Ongoing discussion regarding the ecological importance of old growth forests has been documented in the scientific literature. This discussion indicates that there are no boreal wildlife species that depend entirely on the old growth forest condition for their life cycle requirements (see OMNR 2003, Euler and Wedeles 2005), but that many utilize mature and old seral habitat interchangeably (e.g. Hollaway et al. 2004). For habitat management purposes, the Landscape Guide therefore includes coarse filter indicators for the area of mature and old forest combined. (There are species that favour older forest (e.g. woodland caribou in older lowland spruce forest in the claybelt region of northeastern Ontario); the Landscape Guide has addressed the provision of caribou habitat in separate fine filter indicators (see section 3.2).) Since MNR has developed an explicit Old Growth Policy and the FMPM lists the amount and distribution of old growth as an indicator of objective achievement, old growth is also addressed under a separate indicator in the Landscape Guide. For old growth alone, planning teams are required to explain in the FMP how a supply of old growth by forest unit or appropriate groupings will be maintained on the landscape and how the supply will remain within or move toward the IQR expected under a natural disturbance regime. For additional management direction on old growth forests, refer to the FMPM.

The discussion on old growth can be unclear due to inconsistent use of the terms "old growth" and "mature" forest. For the purposes of this guide, a forest is in a mature stage of development when overstory trees attain full development and sexual maturity, mortality of over-storey trees begins to create gaps and encourages understory development, and height growth slows dramatically. On the other hand, the old growth period is a condition of dynamic forest ecosystems that tends to include complex forest stand structure, relatively large dead standing trees (snags), accumulations of downed woody material, up-turned stumps, root and soil mounds, accelerating tree mortality, and ecosystem functions that may operate at different rates or intensities compared with earlier stages of forest development.

The SRNVs for the old growth by forest management unit are expressed as box and whisker graphs, for example as shown in Figure 8, and provided by forest management unit in OLT and Science Package B series.



**Forest Management Guide for Landscapes - Old Growth Information Sheet**

FMU A – Old Growth SRNV

Boreal East Forest Region Old Growth

***100 – 200 year simulation ranges****

Estimated range of natural variation - "Old Growth"

| | Cochrane Forest | Gordon Cosens Forest | Hearst Forest | Magpie Forest | Martel Forest |
|---|---|---|---|---|---|
| - Lower Quartile | 459,999 | 341,933 | 192,912 | 60,312 | 183,851 |
| ● Lower Range | 232,684 | 160,230 | 95,725 | 32,795 | 101,833 |
| – Median | 509,504 | 393,817 | 202,631 | 70,016 | 217,862 |
| ● Upper Range | 677,278 | 539,921 | 274,443 | 97,227 | 325,906 |
| - Upper Quartile | 532,107 | 462,930 | 223,552 | 80,726 | 248,216 |
| ● Simulation Start | 677,014 | 430,812 | 256,827 | 103,624 | 133,335 |
| □ 50 year median | 861,731 | 395,238 | 307,688 | 81,902 | 272,335 |

* Simulated ranges of natural variation based on 30-200 year simulation replications with measurements taken at simulation years 100,150 and 200. (n=30*3)
** 2006 areas based on the 2006 inventory, 30-50 year simulation ranges based on 30 runs with measurement taken at year 50 (n=30)
Tools used – Boreal Forest Landscape Dynamics Simulator (BFOLDS) and Landscape Scripting language (LSL)
Note: Hearst simulations used 8 runs

**Figure 8. An example SRNV information sheet for the old growth. The SRNV is represented by a box and whisker plot. Indicator values at year 0 of the modelling period (roughly 2006) shown as green dot. The red square represents the value 50 years into the simulation.**

## FMP Application

***Old growth will be defined using Old Growth Forest Definitions for Ontario (OMNR 2003). The old growth development stage of all plan forest units, or appropriate groupings of plan forest units as determined by the forest management planning team, will be represented in strategic forest management models. Planning teams will derive an old growth SRNV for plan forest units, or groupings, based on comparison with the Landscape Guide forest unit SRNV (guideline).***

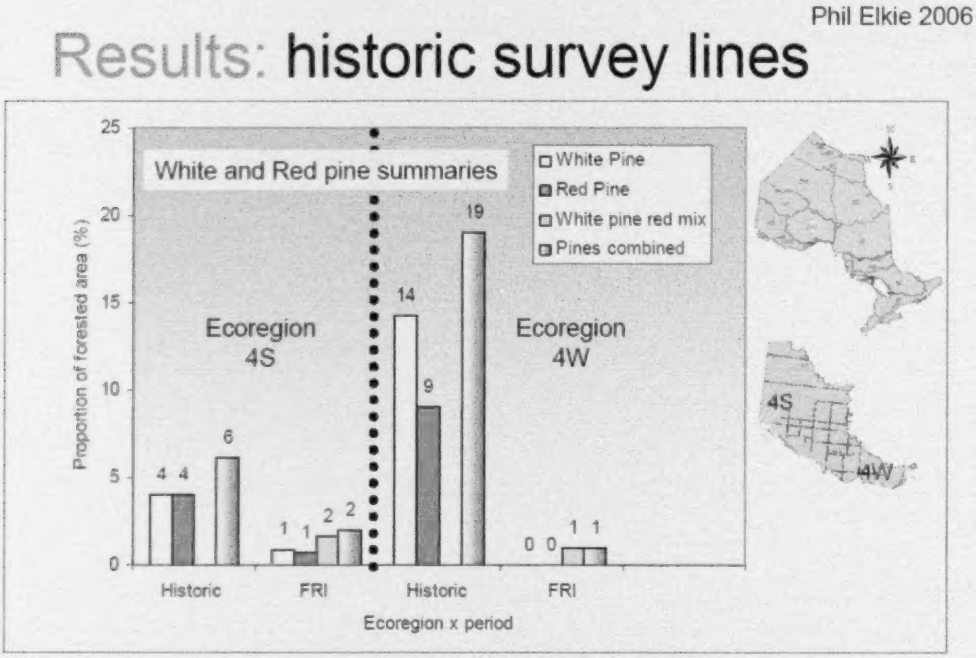
The arrangement of old growth is directed using the texture of the mature and old (which includes old growth) forest indicator (see section 3.1.2.1). Old growth as it functions as habitat for selected wildlife species will be evaluated as part of OMNR's approach to effectiveness monitoring of the Landscape Guide (See section 4).

#### 3.1.1.3 Red and White Pine

The all ages of red and white pine forest units indicator was selected by the science team based on differences between current landscape conditions, pre-industrial condition, and simulated ranges of natural variation. This indicator is used to direct the total amount of area in all development stages of red and white pine forest units on the landscape. This direction is consistent with *Old Growth Policy for Ontario's Crown Forests* (OMNR 2003) which contributes to the maintenance of all ages of red and white pine and includes old growth stands, within their natural geographic ranges by maintaining no less than the 1995 amount while permitting a sustainable harvest of red and white pine now and in the future.

Red and white pine communities occur mostly in the southern parts of the boreal Landscape Guide Regions. However, at the time of running these simulations BFOLDS was limited to stand replacing fires only (i.e., no surface fires). Surface fires are a significant ecological process required to regenerate red and white pine stands. Examination of alternative information for natural disturbance and landscape patterns allowed us to reconcile estimates of the amount of red and white pine in these areas to use as milestones in landscape guide appendices. The Pre-Industrial Condition (PIC) estimate for the all ages of red and white pine forest units' indicator is expressed as percent of forest landscape area and can be found in OLT and Science Package A (Elkie *et al.* 2013b).

Using both the BFOLDS-based SRNVs combined with historic survey-derived milestones is a compatible and valid method for determining direction. Red and white pine estimates fit within the estimate of the mature and older upland conifer landscape class indicator. Forest management planning teams should use professional judgment when applying forest composition guidelines and take into account the contribution of red and white pine forest units to the mature and older upland conifer landscape class.



Phil Elkie 2006

Results: historic survey lines

Proportion of forest in red and white communities.

**Figure 9. An example information sheet from Science Package A (Elkie *et al.* 2013b) the proportion of forest in red and white pine communities. A red and/or white pine community is defined as a stand that contains at least 40% of red and/or white pine combined as a proportion of the overall composition of the stand.**

FMP Application

***Where directed by the Landscape Guide (refer to appendices), forest management plans will represent the total amount of area in all age classes of red and white pine forest units. Planning teams will structure their plan forest units to ensure compatibility with this indicator (guideline).***

***In addition, forest management teams will develop targets to ensure that this indicator does not drop below the 1995 amount (the total number of hectares) (guideline).***

#### 3.1.1.4 Conifer

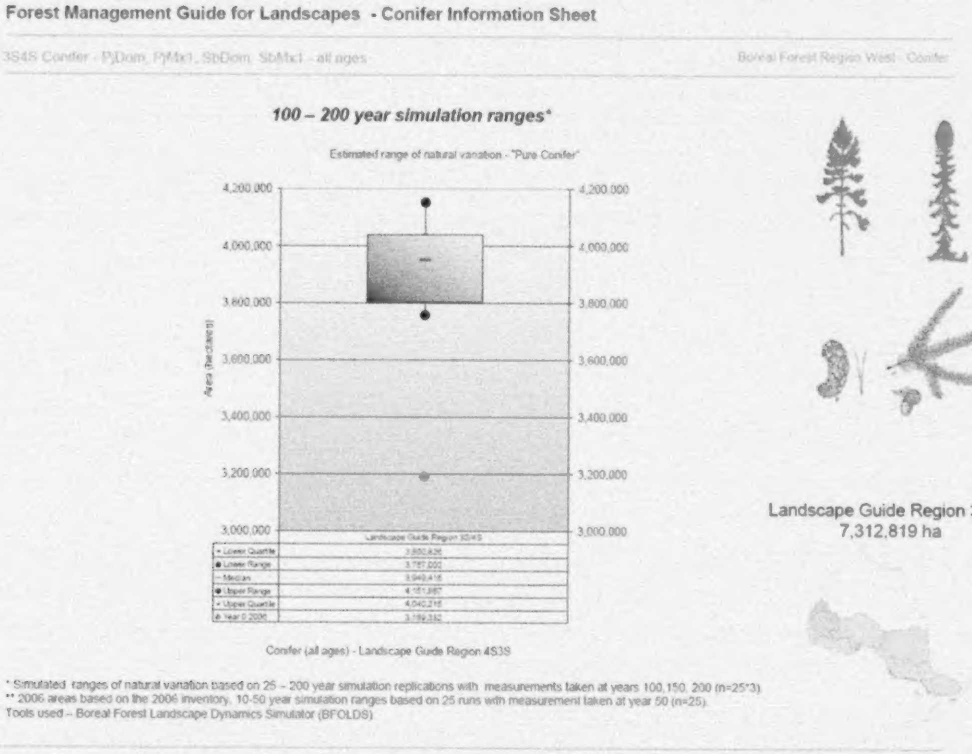
The conifer indicator was selected by the science team based on differences between current landscape conditions, pre-industrial condition, and simulated ranges of natural variation. This indicator is used to direct the total area in all development stages of upland black and white spruce and jack pine forest units on the landscape.

FMP Application

***Where directed by the Landscape Guide (refer to appendices), forest management plans will represent the total amount of area in the following forest unit groupings:***

- ***For landscape guide regions 3S/4S, 3W and 4W: All ages conifer - PjDom, PjMx1, SbDom, SbMx1.***
- ***For landscape guide region 3E, three all age conifer indicators are used including: pine conifer (PJ1 and PJ2), upland conifer (SF1 and SP1) and lowland conifer (Sb1 and Lc1).***

***Planning teams will structure their plan forest units to ensure compatibility with these indicators (guideline).***



**Forest Management Guide for Landscapes - Conifer Information Sheet**

3S4S Conifer - PjDom, PjMx1, SbDom, SbMx1 - all ages

Boreal Forest Region West - Conifer

***100 – 200 year simulation ranges****

Estimated range of natural variation - "Pure Conifer"

| | Landscape Guide Region 3S4S |
|---|---|
| ▪ Lower Quartile | 3,800,826 |
| ● Lower Range | 3,757,002 |
| – Median | 3,940,416 |
| ● Upper Range | 4,151,887 |
| ▪ Upper Quartile | 4,040,216 |
| ● Year 0 2006 | 3,189,332 |

Conifer (all ages) - Landscape Guide Region 4S3S

Landscape Guide Region 3S4S
7,312,819 ha

* Simulated ranges of natural variation based on 25 – 200 year simulation replications with measurements taken at years 100,150, 200 (n=25*3)

** 2006 areas based on the 2006 inventory. 10-50 year simulation ranges based on 25 runs with measurement taken at year 50 (n=25).

Tools used – Boreal Forest Landscape Dynamics Simulator (BFOLDS)

**Figure 10. An example SRNV information sheet for the conifer indicator. The SRNV is represented by a box and whisker plot. Indicator values at year 0 of the modelling period (roughly 2006) shown as green dot.**

### 3.1.1.5 Young Forest

Young forest provides important ecological functions for numerous wildlife species. Forest harvest and wildfire are the dominant disturbance agents that create young forest in boreal forest management units. Although young forest is generally not in short supply, and it is the inverse to mature and old forest, the development team felt it was necessary to include the young forest indicator with general non-time specific "*move towards or maintain within*" direction.

FMP Application

***Young forest is defined as all forest, regardless of origin, less than 36 years in age (standard).***

***Where directed by the Landscape Guide (refer to appendices), forest management plans will account for the total amount of young forest (guideline).***

### 3.1.2 Pattern

Many important concepts in landscape ecology (e.g., fragmentation, edge effects, corridors and connectivity, metapopulation dynamics, reserve size) were developed where forests are not the dominant feature on the landscape (e.g., predominantly agricultural landscapes with islands of residual forest; see Lindenmayer and Franklin 2002, Perera and Baldwin 2000). However, the landscapes where this guide will be applied are very different in that they provide continuous forest cover and the average rate of annual disturbance is less than one percent per year. Numerous studies identified differences in landscape patterns resulting from forest harvest when compared to fire disturbance. Results can vary depending on scale of measurement and spatial proximity rules for defining disturbances. For example, Gluck and Rempel (1996) found clearcut patches to be larger and more irregular in shape than natural disturbances, when comparing individual disturbances. However, Perera and Baldwin (2000) reported the opposite when comparing disturbances across Ontario. Differences of opinion exist about the importance of landscape pattern for biodiversity conservation. For example, there are many empirical and theoretical studies indicating that the primary importance of habitat is its amount rather than its spatial configuration, unless the total amount drops below a certain threshold (e.g., McGarigal and McComb 1995, Drolet et al. 1999, Drapeau et al. 2000, Fahrig 2003, Malcolm *et al.* 2004). Other studies suggest the importance of pattern in affecting habitat quality (e.g. Ferguson and Elkie 2004, Chapin et al. 1998).

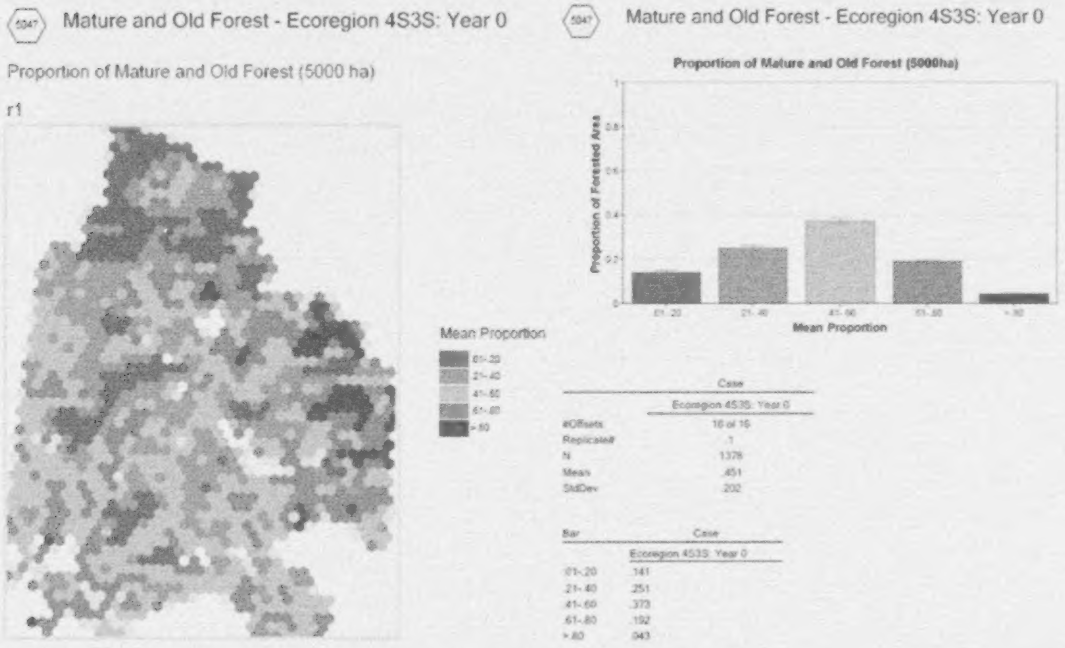
The texture of the mature and old forest and young forest patch size are coarse filter indicators used to characterize landscape pattern in this guide. They are related in many ways: the amount and distribution of young forest patches can affect the texture of the mature and old forest in terms of wildlife habitat (interior loving wildlife species vs. edge loving species), and they are often the result of different forest management actions such as harvesting large or small contiguous areas. Connectivity means different things to different wildlife species and requires a wildlife species-specific assessment of movement across the landscape of interest (e.g. Goodwin 2003). Both of the Landscape Guide pattern indicators indirectly measure connectivity for a range of wildlife species.

FMP Application

The crown land base of some forest management units may be fragmented by a high degree of private land ownership where forest condition information is not available and management intent is unknown. ***Across these units, areas of high ownership fragmentation may be delineated and exempt from application of landscape pattern indicators by forest management planning teams (guideline)***. The crown-land portion of these exempt areas will be considered for landscape structure and composition indicators.

### 3.1.2.1 Texture of the Mature and Old Forest

In landscape ecology terms, the dominant class, however defined, on the landscape is called the matrix. Non-matrix patches are quite easily measured and interpreted using traditional patch-measurement techniques (e.g. McGarrigal and Marks 1995). However, characterizing the pattern associated with the matrix has been identified as a challenge in landscape ecology (e.g. Fahrig 2003). The landscape matrix for most of Ontario's forests is a mature forest. Visually, one can look at a landscape map and see areas in which mature and old forest is arranged in relatively high concentrations, areas with low concentrations and areas that have a relatively medium amount. The texture of the mature and old forest indicator characterizes this matrix by representing the proportions of the landscape in different concentration classes on a histogram – thus quantifying the texture as shown in Figure 11.



| | Case |
|---|---|
| | Ecoregion 4S3S: Year 0 |
| #Offsets | 16 of 16 |
| Replicated# | .1 |
| N | 1378 |
| Mean | .451 |
| StdDev | .202 |

| Bar | Case |
|---|---|
| | Ecoregion 4S3S: Year 0 |
| .01-.20 | .141 |
| .21-.40 | .251 |
| .41-.60 | .373 |
| .61-.80 | .192 |
| >.80 | .043 |

**Figure 11. Texture of the mature and old forest indicator. Concentrations of mature and old forest are mapped on the left hand side of the figure and quantified in a histogram on the right. 5,000 ha hexagons are used in this example with dark green hexagons having high (> 0.80 class) concentrations of mature and old forest and brown hexagons having a low (<0.20 class) amount. In this example, the majority of the landscape has relatively low concentrations (<0.60 class) of mature and old forest.**

Two assessment levels for this indicator are used because it is possible that the texture measurement at one level, as expressed in a proportional frequency histogram, is exactly the same between two landscapes even though the same texture measurement at a finer or coarser level is significantly different. In other words, measuring landscape texture at two levels allows better characterization of the spatial configuration of the landscape than traditional landscape ecology measurements. The age of onset for mature and old forest is defined by forest unit (see Science Package A (Elkie *et al.* 2013b)). The texture of the mature and old forest is measured at 500 and 5000 hectares. These scales were chosen based on sizes of observed and simulated natural disturbances and the ability to capture the character of and appropriately describe the landscape. The quantification technique in OLT works by using the Landscape Scripting Language (LSL) to build and overlay hexagons at the approximate scales of measure. The tool reviews each hexagon and determines i) if it is forested (i.e., 50% or greater of the hexagon contains forest) and ii) the proportion of the forested area that is mature or old. A histogram is generated to represent the relative amount of mature and old in each hexagon (Figure 11).

FMP Application

***Planning teams will use OLT to measure the texture of the mature and old forest indicator or a substitute tool that has received approval from OMNR (standard).***

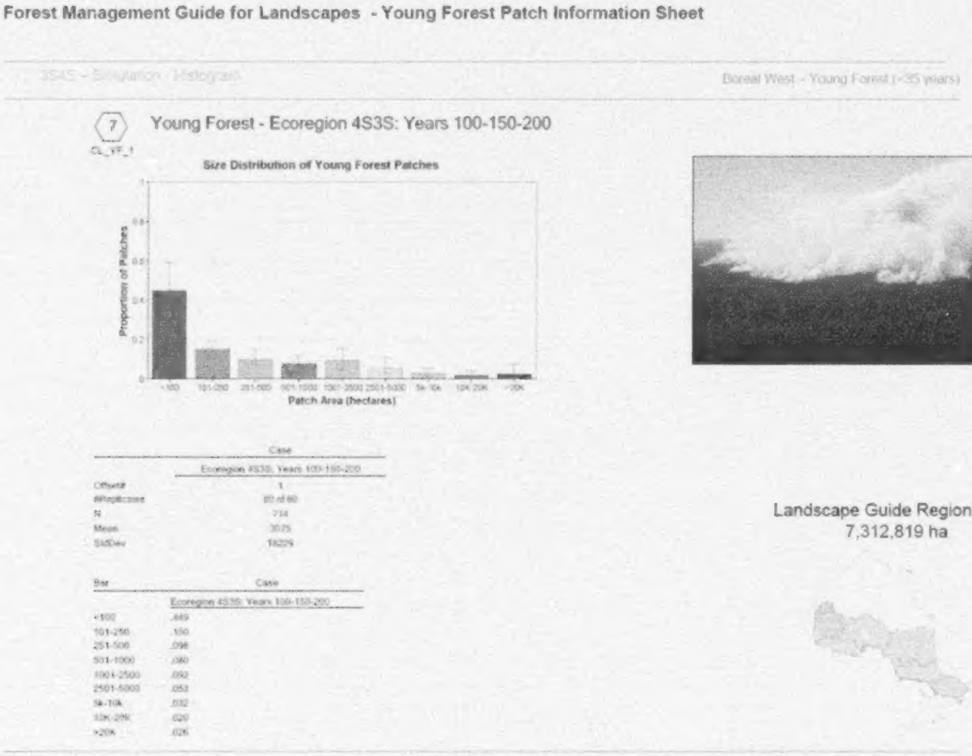
***Texture of the mature and old forest will be measured at plan start year and year 10 of the forest management plan (standard).***

#### 3.1.2.2 Young Forest Patch Size

Patches deal with the shape and size of the homogeneous forest types that make up the landscape mosaic. Like edge, patches have also been the focus of review and analysis in the ecological literature (see Lindenmayer and Franklin 2002, Fahrig 2002). Patch sizes can influence the availability of specific contiguous habitat conditions, an overall landscape mosaic and the amount and distribution of edge (Lindenmayer *et al.* 2000). From a management perspective, experience with past forest management guides in Ontario demonstrated that use of specific patch sizes and shapes can have long-lasting consequences for forests that will require focused efforts over very long time periods to reverse. Thus, it is important to document the forests at these early stages of development to assist in the long term sustainable management of the entire forest.

The young forest patch size indicator uses a histogram to quantify the relative proportion (Y axis) of young forest patches by different patch size classes (X axis) (

Figure 12). Similar to the mature and old forest matrix, young forest (i.e., forest less than 36 years) is measured using a texture technique. Fifteen hectare hexagons are overlaid on the landscape of interest. OLT reviews each hexagon and determines i) if it is forested (i.e., 50% or greater of the hexagon contains forest) and ii) the proportion of the forested area that is young. Each hexagon that has at least 50% of the forested area less than 36 years is classed as young. Young hexagons that are adjacent to each other are counted as the same patch. A frequency distribution of young forest patch sizes is created in nine size classes (i.e., 1-100 ha, 101-250 ha, 251-500 ha, 501-1000 ha, 1001-2500 ha, 2501-5000 ha, 5001-10,000ha, 10,001-20,000 ha and > 20,000ha). Patches less than 16 hectares are not counted.



**Forest Management Guide for Landscapes - Young Forest Patch Information Sheet**

3S4S - Simulation - Histogram

Boreal West - Young Forest (<35 years)

7

CL_YF_1

Young Forest - Ecoregion 4S3S: Years 100-150-200

Size Distribution of Young Forest Patches

| | Case |
|---|---|
| | Ecoregion 4S3S: Years 100-150-200 |
| Offset# | 1 |
| #Replicates | 60 of 60 |
| N | 714 |
| Mean | 3075 |
| StdDev | 18229 |

| Bar | Case |
|---|---|
| | Ecoregion 4S3S: Years 100-150-200 |
| <100 | .449 |
| 101-250 | .150 |
| 251-500 | .098 |
| 501-1000 | .080 |
| 1001-2500 | .092 |
| 2501-5000 | .053 |
| 5k-10k | .032 |
| 10K-20K | .020 |
| >20K | .026 |

Landscape Guide Region 3S4S
7,312,819 ha

Figure 12. Young forest patch size indicator report from Ontario's Landscape Tool (OLT). The histogram describes the relative proportion of young forest patches across the landscape (Y axis) by different patch size classes (X axis).

FMP Application

***Young forest patch size will be measured at plan start year and year 10 of the forest management plan (standard).***

***Planning teams will use OLT to measure this indicator or a substitute tool that has received approval from OMNR (standard).***

## 3.2 *Woodland Caribou*

Forest dwelling woodland caribou require special attention when applying the Landscape Guide. The direction in this guide is generally specific to the forest management unit for which a forest management plan is being developed. However, the Caribou Conservation Plan (CCP) and associated policies, when available, provide broader level provincial direction, including priorities and deliverables required to sustain caribou at both the range and provincial levels.

The Landscape Guide is intended to direct forest management at the landscape scale relying mainly on a coarse filter approach. However, as a result of the release of both the CCP and ESA during the development of the Landscape and Stand and Site Guides, the authors of the guides felt it would be more efficient and effective to include all direction for caribou in a single guide, regardless of the scale at which it would be applied. The Boreal Landscape Guide was chosen as the location to contain this information, since the caribou indicators are a close match to the forest composition indicators (i.e., landscape classes, mature and old forest etc) as described in this guide. Future revisions of this guide should re-evaluate the validity of including the stand and site level direction (see section 3.5.2.1) in this Landscape Guide.

The direction in the Landscape Guide builds upon and supports the priorities in the CCP. By applying the direction in this guide, the fundamental building blocks to success of the CCP will be realized contributing to both the broader population range and provincial level caribou conservation goals.

Although this guide is generally applied at the forest management unit level, caribou conservation, as directed by the CCP, requires landscapes to be assessed (i.e., habitat, disturbance and populations) at much broader levels (i.e., population ranges); consequently assessments and decisions made when applying this guide must recognize the broader caribou landscape as directed by the CCP and its supporting assessments and policy direction.

A coarse filter that emulates natural disturbances and old forest composition, distribution and abundance will generally provide an adequate amount and distribution of caribou habitat and sustainable levels capable of supporting local populations of woodland caribou. The Landscape Guide's forest dwelling woodland caribou habitat fine filter directs forest management to manage the quality, quantity and arrangement of habitat within caribou population ranges (as defined in the CCP and supporting reports), more specifically north of the southern range extent (as defined in the CCP) of the caribou population ranges and within the Landscape Guide regions contributing to and supporting broader caribou range. The indicators described in this section will be used in forest management planning to support a balance between maintaining habitat components across the ranges (e.g. seasonal ranges, high use areas etc.) and creating/renewing habitat components. Section 3.5 of this guide outlines strategic landscape mapping of management actions to conserve biodiversity including the quantity and arrangement of current and future caribou habitat (including winter habitat, mature conifer forest, and refuge (security) habitat) within the natural limits of forest variability.

Woodland caribou require the continued availability of large areas of mature coniferous forest. Typical winter habitat include mature upland conifer forest (e.g. jack pine and black spruce dominated stands, usually with less than 10% hardwoods), especially open stands with relatively low stocking on poorer site classes (i.e. lower productivity) which are often abundant in ground lichen cover. Mature, pure jack pine and black spruce sites on deeper soils may also be suitable, especially when combined and adjacent to exposed lichen-covered bedrock patches. Mature and young forest conditions may be suitable in pure lowland conifer, treed and open bogs and fens, and on shallow soils with low productivity and exposed bedrock.

Predation and predator avoidance through habitat selection is an important aspect of caribou persistence. To avoid predators, caribou disperse across the landscape in low numbers and select refuge (security) habitat which has either large areas of older coniferous forest or peatlands with low diversity. These areas have very little food for moose and deer, and generally support lower numbers of predators.

FMP Application

***Forest management plans will represent woodland caribou habitat in strategic forest management models using region specific habitat classifications (standard).***

Table 6 and Table 7 represent the 2011 region specific habitat classifications. These classifications may change with emerging and new knowledge of caribou. Refer to Science and Information Package "C"aribou for current classifications (Elkie et al. 2013g).

***Planning teams will compare their plan forest units to the Landscape Guide forest units and ensure that there is compatibility with the appropriate caribou habitat classifications (guideline).*** Detailed FRI query description of forest units used in the development of Landscape Guide forest units are provided in Science Package A.

Maintaining high quality and real habitat now and in the future is important for caribou conservation. Preferred habitat (conventional boreal model) and mature conifer (clay-belt boreal model) are those high quality habitats. In the SRNV and accompanying analysis lower quality potential habitat has been identified separately including: useable (conventional boreal model) and winter (clay-belt boreal model). Although these forest types are not as important to caribou, they are beginning to exhibit characteristics of habitat and consequently should be considered when analyzing scenarios. For instance, from a caribou habitat tract map, tracts that are mostly made up of younger 40-60 year old jack pine dominated stands, should be considered as lower quality tracts that with time will become high quality preferred tracts ( i.e. in roughly 20-40 years). Consequently maintaining these younger lower quality habitats will be important when planning for future high quality preferred tracts. However these younger tracts should not contribute or be shown as contributing to current preferred habitat.

**Table 6. Conventional boreal caribou habitat models/classifications as defined in Science Package "C" using Northwest and Northeast Region forest units. A forest stand comes on-line as habitat when it reaches the onset age.**

| *Regional Forest Units* | *Region* | *Onset Age for Habitat (years)* | | |
|---|---|---|---|---|
| | | *Winter Useable* | *Winter Preferred* | *Refuge* |
| BfDom | NW | | | 61 |
| BwDom | NW | | | |
| ConMx | NW | | | 71 |
| HrdMw | NW | | | |
| HrDom | NW | | | |
| OcLow | NW | 51 | | always |
| OthHd | NW | | | |
| PjDom | NW | 41 | | always |
| PjMx1 | NW | 41 | | 41 |
| PoDom | NW | | | |
| PrwMx | NW | | | |
| SbDom | NW | 61 | | 41 |
| SbLow | NW | 41 | | always |
| SbMx1 | NW | 61 | | 41 |
| SF1 | NE | | | 61 |
| BW1 | NE | | | |
| MW1 | NE | | | 71 |
| MW2 | NE | | | 71 |
| LC1 | NE | 51 | | always |
| LH1/TH1 | NE | | | |
| PJ1 | NE | 41 | | always |
| PJ2 | NE | 41 | | 41 |
| PO1 | NE | | | |
| PW1/PR1/PWR | NE | | | |
| SP1 | NE | 61 | | 41 |
| SB1 | NE | 41 | | always |
| SBOG | NE | 41 | | always |

**Table 7 Claybelt boreal caribou habitat models/classifications as defined in Science Package C using Northeast Region forest units. A forest stand comes on-line as habitat when it reaches the onset age.**

| *Regional Forest Units* | | *Onset Age for Habitat (years)* | |
|---|---|---|---|
| | *Region* | *Winter Suitable* | *Mature Conifer* |
| PR1 | NE | | |
| PW1 | NE | | |
| PRW | NE | | |
| LH1 | NE | | |
| SBOG | NE | always | |
| SB1 | NE | 51 | 101 |
| PJ1 | NE | 41 | 71 |
| LC1 | NE | 51 | |
| PJ2 | NE | 41 | 71 |
| SP1 | NE | 51 | |
| SF1 | NE | | |
| PO1 | NE | | |
| BW1 | NE | | |
| MW1 | NE | | |
| MW2 | NE | | |
| TMS | NE | always | |
| RCK | NE | always | always |

### 3.2.1 Texture of Woodland Caribou Habitat

The arrangement and connectivity of caribou habitat is directed by the identification and placement of forest management actions intended to emulate disturbances that will encourage the maintenance and enhancement of caribou range occupancy including developing specific forest composition attributes that allow those landscape patches to fulfill their ecological role for caribou. Habitat tract mapping is a composite portrayal, at the local population range level, of existing habitat based on local knowledge, caribou ecology, observations, and forest cover and landscape information (Science and Information Package Caribou (Elkie et al. 2013g). The arrangement and connectivity of habitat can be quantified by its texture at multiple scales (see Section 3.1.2.1. for a description of measuring landscape texture). This quantification of texture can be used by forest management planning teams to implement the woodland caribou habitat fine filter.

FMP Application

***OMNR will provide habitat tract maps at the local population range level to the forest management planning team as part of the CCP range assessment process (standard).***

***Planning teams will use either OLT to measure the texture of caribou habitat or an equivalent tool that has received approval from OMNR (standard).***

***The texture of woodland caribou habitat will be measured at plan start year and at year 10 (guideline).***

### *3.3 Use Landscape Guide to Set Desirable Levels in FMP*

FMP Application

***The desirable levels for the Landscape Guide indicators will be set as the inter-quartile range (IQR) (for non-spatial indicators) and mean (for pattern indicators) of the SRNV. Specific direction by landscape guide indicator by forest management unit is specified in the milestone tables in the landscape guide appendices (guideline).***

The intent of this guideline is to ensure that the desirable levels for biodiversity objectives in the FMP will represent a science-based estimate of landscape conditions and patterns. The SRNVs were modelled in BFOLDS to reflect a wide range of variation around natural conditions. The inter-quartile range (IQR) represents a suitable management range that excludes extremes in landscape condition that would occur relatively infrequently in nature (see section 2.4.1).

Forest management plans also have forest cover, socio-economic and silvicultural objectives, each with their own desirable levels and targets. These objectives are developed by the planning team and take into consideration direction from the forest management guides. The determination of sustainability, which will reflect, in part, implementation of this ***guideline***, will determine whether, on balance, the ecological, socio-economic, and silvicultural objectives of the FMP are being achieved, and progress is being made towards the desired forest and benefits, consistent with the CFSA principles.

Documentation requirements for biodiversity objectives are outlined in the FMPM. Planning teams may compare (identify any major differences) indicator values between the plan start level, simulation year zero and the desirable level. These values will assist planning teams in identifying reasonable rates of movement toward the desirable level. Discussion may include, but is not limited to: natural disturbances, silvicultural requirements, insect and/or disease issues, socio-economic effects and changes in forest resources inventories (***best management practice***).

### *3.4 Develop Targets for Biodiversity Objectives*

FMP Application

***Forest Management Planning Teams will develop targets for the Landscape Guide indicators that are consistent with Landscape Guide milestones over the short (e.g. 10 years), medium (e.g. 20 years) and long terms (e.g. 100 years)(guideline).***

When developing the long term management direction, the FMPM directs planning teams to consider the direction in forest management guides when balancing social, economic and environmental considerations, all while providing for the sustainability of the Crown forest. The intent of this ***guideline*** recognizes that targets are an outcome of the planning process for which milestones are a planning input. Milestone development considered limited silvicultural, social and economic values that may be better understood at local levels. The documentation requirements regarding targets for Landscape Guide indicators are outlined in the FMPM. Consistent with FMPM direction and as part of the determination of sustainability, application of this *guideline* in a forest management plan will be considered as part of a broader balancing of social, economic and environmental considerations. It is acceptable for some Landscape Guide indicators to have long-term targets outside the IQR providing there is movement towards the desirable level.

***For these objectives that have long-term targets established to encourage movement towards the desirable level, part of the management strategy documentation will discuss an estimate of when the desirable levels will be reached including associated management challenges (guideline).***

Similarly, in some cases the planning team may conclude that, in order to balance achievement or progress for all management objectives, it will be impossible to meet some of the milestones.

***In cases where the achievement of meeting a Landscape Guide milestone conflicts with another management objective and the planning team decides to favour the non-Landscape Guide objective, provide rationale that describes in detail:***

***i) the decision and how it was determined, and***
***ii) the expected time to achieve all affected milestone(s) (guideline).***

Each Landscape Guide region has an appendix to this guide with milestones. Each forest management unit has a milestone table with directional statements for each of the Landscape Guide indicators.

### 3.4.1 Develop Targets for Forest Dwelling Woodland Caribou Habitat Objectives

FMP Application

***In FMPs within or intersecting continuous caribou range (as defined by the CCP), planning teams will develop targets for Landscape Guide caribou habitat indicators for milestones at years 10, 20 and 100 (guideline).***

In FMPs within or intersecting continuous caribou range (as defined by the CCP), planning teams should also develop targets for Landscape Guide caribou habitat indicators at years 40, 60 and 80 (**best management practice**).

Additional direction for developing targets for forest dwelling woodland caribou habitat objectives may be provided from the Caribou Conservation Plan and supporting policies.

***In forest management units that are within or intersect the continuous distribution of caribou, planning teams will describe how the direction provided by the Caribou Conservation Plan was addressed, including the development of a tract based Dynamic Caribou Habitat Schedule (DCHS), and how it is incorporated into targets for Landscape Guide caribou habitat indicators (standard).***

### 3.5 *Identify Large Landscape Patches to Meet Targets*

FMP Application

***Planning teams will identify any large landscape patches (LLPs), using a strategic landscape map, that may be required to meet targets created for Landscape Guide pattern or habitat indicators (e.g. texture of the mature and old forest matrix, young forest patch size, woodland caribou habitat), and allow for the efficient implementation of other guides (e.g. Stand and Site Guide) (guideline).***

LLPs are areas that are used to meet biodiversity objectives and their targets associated with Landscape Guide indicators. A strategic landscape map is a way of identifying those parts of the landscape that are being used to meet spatially explicit biodiversity objectives *and* need to be represented in a strategic forest management model. In other words, the strategic landscape map informs the strategic management model about how the pattern indicators of the Landscape Guide will affect the Long Term Management Direction of the forest.

A DCHS is an example of a mosaic of contiguous LLPs that is used to meet objectives for caribou, and is dependent on a caribou habitat/values tract map. The caribou tract map documents caribou occurrences, including current use and habitat potential of sub-range habitat features across the management unit. This map provides the planning team with a landscape level ecological fabric from which to develop a meaningful DCHS. The DCHS is then used to guide strategic forest management models with an emphasis on the conservation of caribou values.

Each LLP within a DCHS should have a harvest period, usually 20 years long, assigned to it. The harvest period is the time from plan start (0-20, 20-40, 41-60, 61-80....etc.) that the LLP is available for harvest activities. Renewal activities and surveys can occur after the 20 year period but should occur as soon as possible.

The distribution of the mosaic of LLPs making up a DCHS should ensure that habitat is maintained both temporally and spatially in a manner that supports the achievement of the caribou habitat milestones.

***The Planning team should practice judicious use of LLPs by considering the landscape condition at the start of the planning term, past management, natural disturbances, and the SRNV (guideline).***

The following ***best management practices*** are provided to help teams develop strategic landscape maps:

- The size of an LLP relates to the Landscape Guide indicator of interest. For example, in addressing the texture of the mature and old forest measured at 5,000 ha, an LLP should be at least 5,000 ha, but could also be much larger. In the case of caribou where the development of the DCHS is based on the tract map, the size of DCHS LLPs will usually be greater than 10,000 ha.
- Planning teams can design the strategic landscape map starting with the largest, most difficult patches to locate, those that will have an influence on landscape pattern for the longest period of time and/or those LLPs that require special considerations.

- LLPs should only be identified if the planning team determines that spatially explicit management direction needs to be identified in the Long Term Management Direction. For example:
    - Scoping analysis suggests the need for representation.
    - Teams can identify LLPs that have objectives for emphasizing moose or deer habitat using the standards and guidelines of Section 3.0 of the *Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales*.
- It is assumed that the remaining areas not identified as LLPs will be comprised of harvest and retention decisions to complete the landscape mosaic. Not all areas of harvest or retention will be identified as, or incorporated into, the LLPs. These areas also contribute to meeting the overall landscape objectives for the unit.

***Once the planning team determines the appropriate level of detail, each LLP requires the following documentation (guideline):***

a. ***Where: Identification of the LLP using a system of numbering.***
b. ***What and Why: What targets are met by the LLP (indicate landscape indicators(s) or specific fine filter objective).***
c. ***When: When will these areas be managed (use 20 year periods). The strategic landscape map should identify prioritized management actions for spatially explicit indicators (i.e. pattern and habitat) over a length of time sufficient to demonstrate movement into and maintenance within desired ranges of variation.***
d. ***How (for LLPs within the 20 year planning period): Describe what management actions will be taken in the LLP including a description of anticipated silviculture. In cases where an LLP is managed to create specific fine filter conditions the stated DFFC must produce these conditions (e.g. a LLP managed for woodland caribou habitat must have a Desired Future Forest Condition that provides woodland caribou habitat). Describe how the LLP was taken into account in strategic modelling of proposed management strategy (e.g. available for harvest, deferred harvest, additional residual, specific silviculture, etc.).***
e. ***Roads (for LLPs within the 20 year planning period): Description of the expected length of time that planned or existing roads within the LLP will be required to carry out management actions. This documentation does not replace or direct road access planning; however, it can be used as input to the development of a roads strategy.***

### 3.5.1 Using Large Landscape Patches for Applying Fine Filter Direction for Moose or Deer

Ideally, when applying the coarse filter, biodiversity at the landscape level will be maintained and perhaps enhanced. Management of stand-level habitat features (e.g. cavity nests, snags, down woody material, moose aquatic feeding areas and calving areas) that may occur on the landscape is directed in the *Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales* (the stand and site guide) (OMNR 2010). However, in some cases, deer and moose may require special landscape consideration. Ontario's Cervid Ecological Framework (OMNR 2009b) provides broad population and habitat management guidance by Cervid Ecological Zones. These zones should be considered when developing large landscape patches with objectives for moose or deer.

FMP Application

***When objectives exist for moose, deer or other wildlife, their habitat will be evaluated using models (available in OLT) to determine if application of the coarse filter direction of the Landscape Guide is contributing to these objectives. Identification, arrangement, and planning of deer winter concentration areas and yards, or the arrangement of moose habitat on the landscape should be planned using a hierarchy of Landscape Guide analysis techniques. Firstly, the SRNV of the amount of habitat (when available) should be considered at the management unit level and the contribution of the habitat SRNV at the deer or moose area level should be considered relative to that broader landscape. Secondly, the pattern within either large deer winter concentration areas and yards or moose areas should be planned i) in a manner that enhances habitat within the deer or moose area and ii) in a way that contributes to the broader landscape pattern objectives (guideline).***

### 3.5.2 Using Large Landscape Patches for Applying Fine Filter Direction for Woodland Caribou

In Forest management units within or that intersect continuous caribou distribution, (as defined by the CCP), LLPs are used to manage a sustainable supply of year round caribou habitat that can also be considered a dynamic caribou habitat schedule. Information from integrated range assessment reports will provide availability and suitability of range components (seasonal ranges, high use areas, and calving sites) through time.

FMP Application

***In accordance with the strategic evaluation of caribou habitat, forest management planning teams will identify how LLPs on the habitat tract maps are incorporated into a DCHS that will be used to meet forest management objectives (e.g. maintain woodland caribou habitat within the SRNV) (guideline).***

***Forest management planning teams will give priority to identifying LLPs with the greatest current value for caribou (guideline).***

Management examples include maintaining currently used winter habitat areas until adjacent comparable habitat becomes available, using large patches of young conifer dominated forest to provide future habitat that allow caribou to re-occupy previous used or alternate habitat tracts, and identifying a defragmentation strategy to reduce edge and internal structure.

The following factors can be considered when developing LLPs to meet woodland caribou habitat objectives (***best management practice***):

- The texture of caribou habitat is measured at 6,000 and 30,000 ha. LLPs should be developed that support “movement towards” the caribou habitat texture indicators desirable levels. Developing LLPs smaller than 6,000 ha (i.e., the finest scale of habitat texture assessment) would contribute to landscape fragmentation of habitat.
- Landforms and soils with high capability (e.g. coarse dry soil, rock outcrops and generally areas with a legacy of ecosites that support ground lichens) to support winter habitat.
- Topographic and landform features with a high capability to support refuge during calving and summer habitat. These areas are usually large areas of mature and older jack pine and spruce dominated forest.
- The location of calving and nursery areas and known travel routes documented using the habitat tract maps, and strategic linkages or connectivity to other ranges, seasonal ranges or habitats.
-

- Primary roads and road corridors, which should be planned in a way that does not fragment traditional winter habitat tracts.

- Appropriate silvicultural intervention to produce suitable winter and refuge habitat described above. This will require a specific written statement of intended silvicultural outcomes (species composition, stocking, structure) and approaches for LLPs that link to specific desired forest condition.
- The planned duration of forest access roads, when constructed in significant winter or snow-free season habitat tracts, which should be coincident with the time required to carry-out the management activities required to complete the silviculture necessary to reach the desired future forest condition.
- Other industrial, recreational or commercial developments within the landscape that contribute or may contribute to cumulative impacts on caribou habitat, its effectiveness, or on caribou behavior or population dynamics (e.g. mining or mineral developments, linear features, tourism establishments, recreational patterns or infrastructure).

### 3.5.2.1 Stand and Site Level Direction for Woodland Caribou Habitat

Areas where there are objectives to emphasize caribou habitat management will also be identified through application of the Forest Management Guide for Boreal Landscapes. Unless otherwise specified, the standards, guidelines and best management practices of this Section will apply to the areas where there are objectives to emphasize caribou habitat. This includes 'caribou mosaic blocks' planned during implementation of the Forest Management Guidelines for the Conservation of Woodland Caribou (OMNR 1999).

FMP Application
Link with FMPM section 4.7.3 Assessment of Regeneration Success

The format of the following direction follows that used in the Stand and Site Guide (OMNR 2010).

| Species | Woodland Caribou |
|---|---|
| Standards | • Silvicultural prescriptions will be consistent with woodland caribou habitat management objectives. |
| Guidelines | • To maintain or provide a long-term supply of suitable woodland caribou habitat, the following principles will be applied:<br>i. harvest stands in large contiguous tracts;<br>ii. regenerate contiguous harvest tracts to a conifer dominated, shrub and herb-poor forest condition, of similar age class distribution (i.e., creating even-aged class structure);<br>iii. minimize the amount of residual forest and prevent conversions to mixedwoods or hardwoods in all harvest blocks (e.g., to the extent possible, residual forest will be associated only with AOC prescriptions or CROs (conditions on regular operations); see Sections 3.2 of the stand and site guide (OMNR 2010) for further information on stand pattern, composition and structure);<br>iv. where the objective includes a future forest condition that is pure conifer (jack pine and/or black spruce and/or white spruce only), as measured over the multi-stand cutblock area, create silvicultural objectives and use silvicultural treatments that prevent increases in balsam fir and hardwood and keep them from exceeding their natural (e.g., pre-harvest) levels; and<br>v. maintain pattern, stand structure and composition objectives consistent with objectives for the LLP. |

| Species | Woodland Caribou |
|---|---|
| | • Emphasis on the management of caribou winter feeding habitat will occur in areas identified as having been used by caribou as winter feeding habitat, or specific areas with a high potential to develop into winter feeding habitat. In these areas, the following direction will apply:<br>i. on dry upland conifer sites conducive to lichen rich ground cover (e.g., *Cladina* spp.), use silvicultural practices to maintain or enhance jack pine or black spruce stands that favour the lichen rich ground cover condition; and<br>ii. in lowlands (e.g., lowland black spruce; treed bogs) and shoreline forests, where feasible and consistent with site conditions, use silvicultural practices to maintain or enhance black spruce stands that favour the growth of arboreal lichens (e.g., *Bryoria* spp.).<br>• To manage for calving and nursery habitat (e.g., large lakes with islands, complexes of smaller lakes, or open peatland complexes with treed islands):<br>i. include these habitats in caribou tracts and schedule them for protection or harvest consistent with habitat tract pattern and composition objectives developed through implementation of this guide;<br>ii. proceed with allocation and harvest of a habitat tract with known or potential calving sites and nursery areas provided they are in an unsuitable condition (e.g. over mature, with a dense understory of shrubs such as raspberry); or if there is a sufficient supply of calving and nursery habitat in suitable condition on the management unit. For example, forest operations could occur if at least one third of the forest stands on the perimeter and islands of a known, large calving/nursery lake were retained or maintained in a suitable condition. Stands in suitable condition are generally mature, conifer dominated, sparsely to well-stocked, with a relatively open understory. Suitable calving and nursery habitat will also be contiguous with tracts of mature, conifer dominated forest cover; and<br>iii. for known calving sites and nursery areas that are in a suitable condition, establish a 1 km area of concern (AOC) and do not conduct forest operations within the AOC from May 1 to August 15.<br>• To minimize the potential negative impacts to caribou populations associated with forest roads and road networks:<br>i. where it is reasonable to do so, avoid traditional and potential high quality caribou habitat tracts (i.e., tracts which contain calving sites and nursery areas, and/or winter feeding habitats) when planning primary (permanent) road locations; and<br>ii. adopt road use management strategies for primary, branch and operational roads consistent with caribou management objectives and approved actions identified in the CCP. |
| Best Management Practices | • Harvest operations in caribou tracts should be concluded as quickly as possible, ideally 10 years; the maximum time should be no more than 20 years after the commencement of operations.<br>• Renewal of conifer dominated stands, especially fine textured soils, should occur within two years of harvest to minimize ingress of deciduous trees and shrubs, maximize regeneration potential and shorten the time to stand closure. |

| Species | Woodland Caribou |
|---|---|
| | • Following large wildfires or blowdown, consider allocation of harvest blocks adjacent to the perimeter of the wildfire, consistent with direction on landscape pattern and composition provided elsewhere in this guide. If salvage operations are planned within the perimeter of the fire, use practices consistent with maintenance or enhancement of spruce and/or jack pine content.<br>• The development of road use management strategies in areas where there is an objective to maintain or provide caribou habitat should consider:<br>i. minimizing the amount of road construction and increasing normal skid distances;<br>ii. minimizing public access restrictions (e.g. gates, signs), providing for both public and commercial travel on forestry roads and road networks for the period of time forest operations are occurring within a LLP (i.e. a DCHS or mosaic block) or until harvested areas have begun to decline in quality with respect to moose feeding habitat (e.g., 20 years following harvest);<br>iii. the use of winter roads where feasible;<br>iv. decommissioning operational roads as quickly as possible following cessation of forest operations; and<br>v. regenerating operational roads, branch roads and branch road networks to conifer (other than balsam fir) as soon as possible. |

### 3.5.2.2 Assess Caribou Habitat Provision

Assessment of caribou habitat provision at the landscape, stand and site scales will be discussed in the plan text to demonstrate how the areas selected for harvest contribute to the achievement of the targets and objectives for caribou habitat objectives.

FMP Application

***Generate a time slice (20-year increments) analysis of how application of the landscape guide caribou habitat indicators provides for a sustainable supply of year-round caribou habitat (guideline)***.

***For each projected twenty-year time period described in the time-slice map, ensure that the projected amount and arrangement of caribou habitat, at the landscape level, supports the long-term management direction and milestone achievement (guideline).***

This analysis uses integrated range assessment reports for context to demonstrate (using the strategic landscape map) the management unit contribution to availability and suitability of sub-range habitat features (seasonal ranges, high use areas, calving sites etc.) through time.

# 4 Monitoring, Evaluating and Reviewing the Landscape Guide

Monitoring, evaluating and reviewing the Landscape Guide will consider effectiveness, efficiency and effects. Testing effectiveness will evaluate if the Landscape Guide is contributing to biodiversity conservation as intended relative to a natural reference condition. On the other hand, testing efficiency will test effects on forest management planning in relation to previous forest management guides. More detailed information about effectiveness monitoring can be found in Effectiveness Monitoring of Forest Management Guides: Strategic Direction (Rempel *et al.* 2011)

## *4.1 Effectiveness: Evaluating the effectiveness of the Landscape Guide*

The CFSA implicitly states that emulation of natural disturbance and landscape patterns is an effective approach to ensuring long-term health of forest ecosystems. This approach, however, is still a hypothesis, and the direction provided in the Landscape Guide is consistent with the intent of this policy. In essence, the hypothesis predicts that by emulating the structure, composition and pattern of natural forest ecosystems through forest management, the natural patterns of biodiversity and ecological processes will be maintained in managed areas. Landscape Guide indicators were developed for structure, composition and pattern (section 3). Each element of guide direction results in expected outcomes that arise from the "emulation of natural disturbance hypothesis". Some of these expected outcomes are more uncertain than others. The Effectiveness Monitoring of Forest Management Guides: Strategic Direction (Rempel et al. 2011) and its associated work plans translate key elements of guide direction into explicit hypotheses. Predictions with high levels of uncertainty are identified and become priorities for effectiveness monitoring.

The CFSA requires the determination of sustainability with respect to the conservation of biodiversity and ecological processes. The response of a forest ecosystem to forest management and natural disturbance can be measured at the levels of species richness, population trends, community organization and functional properties. These three classes are used to organize a strategy to monitor the effectiveness of landscape guide in conserving both biodiversity and ecological processes (see section 4.1).

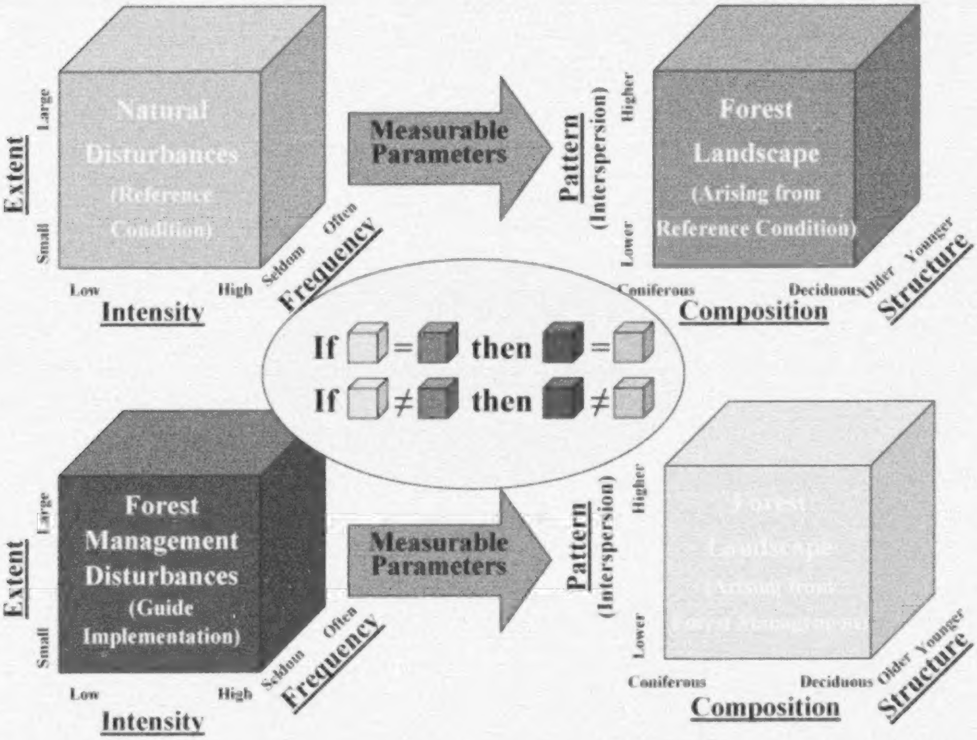


**Figure 13. Predicted relationships between pattern, composition, and structure and forest management disturbances versus natural disturbances. The boxes represent characteristics of disturbances (frequency, intensity and extent) or landscapes (structure, composition and pattern). Under the hypothesis that forest management (lower left box) emulates key characteristics of natural disturbances (upper left box) the use of the Landscape Guide is predicted to result in similarities between unmanaged landscape structure composition and pattern (upper right box) and the managed areas (lower right box).**

Evaluating the effectiveness of the Landscape Guide is based on the prediction that forest management will result in landscapes that are similar to those created from natural disturbance in terms of their community structure, population trends and ecological processes. This prediction will be evaluated by comparing forest landscapes represented by the grey box to those represented by the green box respectively (Figure 13). The community structure component of the effectiveness monitoring plan will require an evaluation of vegetation and wildlife communities between the managed (grey box) and reference (green box) landscapes. This comparison will be assessed by finding landscapes that are similar to both the managed (grey box) and reference (green box) landscapes and measuring Landscape Guide indicators and wildlife abundance. Following this evaluation, we could assess outcomes of forest management planning following Landscape Guide direction for structure, composition and pattern (described as milestones in section 2.4.1).

The Landscape Guide will take several years to implement across Ontario and changes in many Landscape Guide indicators will occur over the long term. Predicted changes in wildlife abundance (population trends) (based on the community structure evaluation) can be made by evaluating predicted landscape changes described as milestones in section 4 of the guide. For example, if we expect an increase in the amount of young jack pine in a given Landscape Guide region then we should expect to see an increase in the abundance and distribution of species that prefer young jack pine forest as habitat, such as the spruce grouse and hermit thrush. The population trends monitored at the Landscape Guide region level (Figure 1) can then be used to distinguish wildlife responses to factors related to Landscape Guide direction from other non-guide factors (e.g. winter habitat for migratory songbirds, insects, etc.). OMNR has a lead role in designing scientific studies to evaluate the effectiveness of forest management guides (EA condition 31) and monitoring wildlife populations to support guide effectiveness monitoring (EA condition 30). This component of the effectiveness monitoring plan integrates and expands existing monitoring programs housed at the Ontario Terrestrial Assessment Program (ONTAP).

The ecological processes component of the plan will require an evaluation of ecological processes between the managed (grey box) and reference (green box) landscapes. This component of the monitoring plan explicitly addresses the mandate to assess sustainability in terms of how well ecological processes are conserved and refers to a broad class of potential monitoring projects, and principally relates pattern to process through indicators. Some examples of projects currently underway include: evaluating regeneration success (maintaining primary production of conifer and deciduous trees), habitat-selection dynamics of moose (including response to enhanced habitat management to resemble large, medium intensity burns), habitat selection and predator-prey dynamics involving caribou, moose, and wolves, and predator-prey dynamics involving marten and small mammals.

### *4.2 Effects: Identifying effects on other values*

Implementation of the Landscape Guide in forest management plans may have a positive, negative or neutral effect on other values relative to previous forest management guides. Such effects are part of the main uncertainties of Landscape Guide direction and will be considered by OMNR during the future review of the Landscape Guide. The following is a partial list of potential effects of Landscape Guide implementation that will be monitored as part of the guide effectiveness monitoring:

- Changes in forest access road density and/or distribution.
- Changes in available harvest area.
- Planning team effort required to learn and implement the Landscape Guide.
- Changes in wildlife habitat for wildlife species valued by stakeholders.
- Changes in wildlife habitat for wildlife species valued by stakeholders relative to distance from forest access road network.
- Changes in forest access road networks relative to water bodies.

### *4.3 Efficiency: Reviewing the Landscape Guide*

The Forest Management Class EA approval requires OMNR to review forest management guides periodically to determine if a revision is required. This guide will be reviewed in accordance with the EA approval and will consider, but not be limited to, revisions to the guide based on:

- Effectiveness of the Landscape Guide direction. What have we learned from the results of relevant and appropriate monitoring programs?
- Efficiency and Effects: What are the advantages and disadvantages of the Landscape Guide compared with previous forest management guides? Specifically, this will consider the efficiency of the Landscape Guide along with effects on other values.
- New Science and Information: What applicable scientific research and advances in analytical and operational technology have occurred?

## 5 Literature Cited

Aird, P. L. 1985. In Praise of Pine: The Eastern White Pine and Red Pine Timber Harvest from Ontario's Crown Forest. Can. For. Serv., Petawawa National Forestry Institute, Report No. PI-X-52.

ArborVitae Environmental Services Ltd., CMC Ecological Consulting, and Callaghan and Associates Inc. 2000, Review of Forest Management Guides. Report Submitted to the Provincial Forest Technical Committee.

Baker, J. A. 2000. Adaptive Management at the Landscape Level. Pages 310-322 in A. H. Perera, D. L. Euler, and I. D. Thompson, editors. Ecology of a managed terrestrial landscape: patterns and processes of forest landscapes in Ontario. University of British Columbia Press, Vancouver, British Columbia, Canada.

Bellhouse, TJ and BJ Naylor. 1997. Habitat relationships of wildlife in central Ontario. OMNR, Southcentral Science and Technology, Technical Report No 53. Queens Printer for Ontario.

Bunnell, P. 2003 The adaptive cycle in a forest: Resilience Alliance (3.1) URL: www. resalliance.org.

Bush, P.G. 1999. Influence of landscape-scale forest structure on the presence of pileated woodpeckers (Dryocopus pileatus) in central Ontario forests. MScF Thesis, Lakehead Univ., Thunder Bay. 87pp.

Carleton, T. J. 2000. Vegetation responses to the managed forest landscape of central and northern Ontario. Pages 179--197 in A. H. Perera, D. L. Euler, and I. D. Thompson, editors. Ecology of a managed terrestrial landscape: patterns and processes of forest landscapes in Ontario. University of British Columbia Press, Vancouver, British Columbia, Canada.

Carleton T.J. and P. MacLellan. 1994. Woody vegetation responses to fire versus clear-cut logging: a comparative survey in the central Canadian boreal forest. Ecoscience 1: 141-152.

Chapin, T.G., Harrison, D.J., and Katnik, D.D. 1998. Influence of landscape pattern on habitat use by American marten in an industrial forest. Conservation. Biology. 12: 1327–1337.

Chapin, F.S.III, Lovecraft, Amy L., Zavaleta, Erika S., Nelson, Joanna, Kofinas, Gary P., Trainor, Sarah F., Huntington, Henry P., Robards, Martin, Naylor, Roamond L.. 2006. Policy Strategies to address sustainability of Alaskan boreal Forests in response to a directionally changing climate. Proceedings of the National Academy of Sciences of the U.S. Vol. 103 Issue 45, p 16637-16643.

Colombo, S.J., W.C. Parker, N. Luckai, Q. Dang, and T. Cai. 2005. The effects of forest management on carbon storage in Ontario's forests. Ont. Min. Nat. Res., Appl. Res. Dev. Br., Sault Ste. Marie, ON. Climate Change Res. Rep. CCRR-03. 126 p.

Colombo, S.J., 2008. Ontario's Forests and Forestry in a Changing Climate. Climate Change Research Report CCRR-12. Queen's Printer for Ontario.

Crawford, S., S. Matchett & K. Reid. 2005. Decision Analysis/Adaptive Management (DAAM) for Great Lakes fisheries: a general review and proposal. Draft discussion paper presented at IAGLR (International Association for Great Lakes Research) 2005 University of Michigan, Ann Arbor, Michigan USA. 54+ pp.

D'Eon RG and WR Watt. A Forest Suitability Matrix for Northeastern Ontario. 1994. NEST Technical Manual TM-004. Queens Printer for Ontario.

Drapeau, P. et al. 2000. Landscape-scale disturbances and changes in bird communities of boreal mixed-wood forests. Ecological Monographs 70: 423–444.

Drolet, B., Desrociiers, A. and M.J. Fortin. 1999. Are songbirds affected by landscape structure in exploited boreal forest? Condor 101: 699-704.

Elkie, P., A. Smiegielski, M. Gluck, J. Elliott, R. Rempel, R. Kushneriuk, B. Naylor, J. Bowman, B. Pond and Derek Hatfield. 2013a. Ontario's Landscape Tool. Ontario Ministry of Natural Resources. Forest Policy Section. Sault Ste. Marie Ontario.

Elkie, P., M. Gluck, J. Boos, J. Bowman, C. Daniel, J. Elliott, D. Etheridge, D. Heaman, G. Hooper, R. Kushneriuk, G. Lucking, S. Mills, B. Naylor, F. Pinto, B. Pond, R. Rempel, K. Ride, A. Smiegielski, G. Watt, M. Woods. 2013b. Science and Information in support of Ontario's Forest Management Guides for Landscapes: Science Package – Series A: Simulations, Rationale and Inputs. Version 2013. Ontario Ministry of Natural Resources. Forest Policy Section.

Elkie P, Gluck M, J. Elliott, D. Etheridge, D. Gagnon, G. Hooper, R. Kushneriuk, R. Leith, G. Lucking, M. Malek, S. Mills, R. Rempel, A. Smiegielski, B. Watt. 2013c. Science and Information in support of Ontario's Forest Management Guides for Landscapes: Science Package - Series B: Results: Landscape Guide Region 3E. Ontario Ministry of Natural Resources, Forest Policy Section.

Elkie, P., M. Gluck, J. Elliott, G. Hooper, R. Kushneriuk, Rempel, K. Ride, A. Smiegielski. 2013d. Science and Information in support of Ontario's Forest Management Guides for Landscapes: Science Package - Series B: Results: Landscape Guide Region 3W. Ontario Ministry of Natural Resources, Forest Policy Section.

Elkie, P., M. Gluck, J. Elliott, G. Hooper, R. Kushneriuk, Rempel, K. Ride, A. Smiegielski. 2013e. Science and Information in support of Ontario's Forest Management Guides for Landscapes: Science Package - Series B: Results: Landscape Guide Region 3S/4S. Ontario Ministry of Natural Resources, Forest Policy Section.

Elkie, P., M. Gluck, J. Elliott, G. Hooper, R. Kushneriuk, Rempel, K. Ride, A. Smiegielski, 2013f. Science and Information in support of Ontario's Forest Management Guides for Landscapes: Science Package - Series B: Results: Landscape Guide Region 4W. Ontario Ministry of Natural Resources, Forest Policy Section.

Elkie P., K. Green, G. Racey, M. Gluck, J. Elliott, G. Hooper, R. Kushneriuk and R. Rempel, 2013g. Science and Information in support of Policies that address the Conservation of Woodland Caribou in Ontario: Occupancy, Habitat and Disturbance Models, Estimates of Natural Variation and Range Level Summaries. Electronic Document. Version 2013. Ontario Ministry of Natural Resources, Forest Policy Section.

Elkie, P., R. Rempel, B. Naylor, M. Gluck, J. Elliott, R. Kushneriuk, 2013h. Science and Information in support of Policies that address Landscape Level Moose Requirements: Science Package - Series B, Habitat Definitions, Models and Simulation Results. Ontario Ministry of Natural Resources, Forest Policy Section.

Euler, D. and C. Wedeles. 2005. Defining old growth in Canada and identifying wildlife habitat in old growth boreal forest stands. National Council for Air and Stream Improvement, Research Triangle Park, North Carolina. Technical Bulletin 909.

Fahrig, L. 2002. Effect of habitat fragmentation on the extinction threshold: a synthesis. Ecological Applications 12: 346-353.

Fahrig, L. 2003. Effects of habitat fragmentation on biodiversity. Annual Reviews of Ecology and Systematics 34: 487-515.

Ferguson. S.H and P.C. Elkie. 2004. Habitat requirements of boreal forest caribou during the travel seasons. Basic and Applied Ecology 5 (2004) 465-474.

Franklin, J. F., 1993. Preserving biodiversity: species, ecosystems or landscapes. Ecological 1 Applications, 3, 202-205.

Fryxell, J.M., I. Thompson and J. Baker. 2008. Population Ecology of Marten (Martes americana) In the Boreal Forests of Northern Ontario. Final report for NSERC, Forest Ecosystem Research Cooperative Inc, Canadian Forest Service, and Ontario Ministry of Natural Resources.

Gluck, M.J. and R.S. Rempel. 1996. Structural characteristics of post-wildfire and clear-cut landscapes. Environmental Assessment and Monitoring. 39:435-450.

Goodwin, B. 2003. Is landscape connectivity a dependent or independent measure? Landscape Ecology18 (7) 687 - 699.

Gunderson, L.H. and C. S. Holling, eds. 2002. Panarchy: Understanding Transformations in Human and Natural Systems. Island Press. 507 pp.

Hanley, T.A., and C.L. Rose. 1987. Influence of overstory on snow depth and density in hemlock-spruce stands: implications for deer management in southeastern Alaska. USDA For. Serv., PNW-RN-459. 11 p.

Hearnden, K.W., S.V. Millson, and W.C. Wilson. 1992. A Report on the status of Forest Regeneration. Ont. Min. Natur. Resourc. Independent Forest Audit Committee. Queen's Printer for Ontario. Toronto, ON. 117 pp.

Holling, C.S. 1978. Adaptive Environmental Assessment and Management. John Wiley & Sons, Chichester.

Holloway, G., B. Naylor, and W. Watt, Editors. 2004. Habitat Relationships of wildlife in Ontario – revised habitat suitability models for the Great Lakes-St. Lawrence and Boreal East Forests. OMNR, Science and Information branch, Southern Science and Information and Northeast Science and Information. Joint Technical Report No. 1. Queen's Printer for Ontario. 120 pp.

Howard, R.A. 1966. Decision analysis: applied decision theory. pp. 55-71. In: D.B. Hertz & J. Melese (ed.) Proceedings of the Fourth International Conference on Operational Research, Wiley-Interscience.

Hundertmark, K.J. 1998. Home range, dispersal and migration. In Ecology and management of the North American moose. Franzmann, A.W. and C.C. Schwartz, Eds. Smithsonian Inst. Press. Wash. and London. pp 303-335.

Hunter, ML 1990. Wildlife, forests, and forestry: principles of managing forests for biological diversity. Prentice Hall, Inc. Englewood Cliffs, NJ 370 pp.

IPCC. 2007. Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY. 851 p.

Johnson, E.A, K. Miyanishi, and S.R.J. Bridge. 2001. Wildfire regime in the boreal forest and the idea of suppression and fuel buildup. Conservation Biology 15 (6) 1554-1557.

Jones, M. & T. Nudds. 2003. Draft principles of Decision Analysis and Adaptive Management, Prepared for the Saugeen Ojibway/Canada/Ontario Plenary. 14 February 2003. 1pp.

Karr, James R. 1991. "Biological integrity: A long-neglected aspect of water resource management." Ecological Applications 1:66–84.

Karr, James R. (1996). "Ecological Integrity and Ecological Health Are Not the Same." In Engineering Within Ecological Constraints, ed. Peter C. Schulze. Washington, DC: National Academy Press

King, D.I., R.M. DeGraaf, C.R. Griffin. 2001. Productivity of early successional shrubland birds in clearcuts and groupcuts in an eastern deciduous forest. Journal of Wildlife Management 65:345-350.

Lee K.N. 1993. Compass and Gyroscope. Island Press.

Lindenmayer, D.B., Margules, C.R., Botkin, D.B. 2000. Indicators of biodiversity for ecologically sustainable forest management. Conservation Biology 14 (4): 941-950.

Lindenmayer, D.B. and J.F.Franklin, 2002. Conserving Forest Biodiversity: A Comprehensive Multiscaled Approach. Island Press. 352 pp.

Malcolm, J.R, B.D. Campbell, B.G. Kuttner, and A. Sugar 2004. Potential indicators of the impacts of forest management on wildlife habitat in northeastern Ontario: A multivariate application of wildlife habitat suitability matrices Forestry Chronicle 80:91-106.

Mattfeld, G.F. 1974. The energetics of winter foraging by white-tailed deer. A perspective on winter deer concentration. State University of New York, Ph. D.
Thesis. 306 p.

McCann, K.S. 2007. Protecting Biostructure. Nature. Vol. 466: 29-30.

McGarigal, K. and B.J. Marks. 1995. FRAGSTATS: spatial pattern analysis program for quantifying landscape structure. Program documentation. Gen Tech Rep US Dep Agric For Serv Pac Northwest Res Stn 351, Portland.

McGarigal, K. and W.C. McComb. 1995. Relationships between landscape structure and breeding birds in the Oregon Coast Range. Ecological Monographs 65:3 pp. 235-260

Naylor, B.J. 1998. Integrating timber and wildlife habitat management. Section 8.0 *In:* OMNR, 1998. A silvicultural guide for the Great Lakes-St. Lawrence conifer forest in Ontario. Version 1.1. OMNR, Queen's Printer for Ontario, Toronto.

Naylor, B., S. Mills, and L. Landriault. 2005. Evaluating the importance of marten cores to trapper harvests: final report for phase I. Forest Ecosystem Science Co-operative Technical Report.

OMNR. 1980. Moose Management Policy. Queen's Printer for Ontario.

OMNR. 1988. Timber Management Guidelines for the Provision of Moose Habitat. Queen's Printer for Ontario.

OMNR. 1990. Featured Species Policy. Wildlife Branch Policy No. 6.04.01.

OMNR. 1996a. Forest Management Guidelines for the Provision of Marten Habitat. Queen's Printer for Ontario. 30 p.

OMNR. 1996b. Forest Management Guide for the Provision of Pileated Woodpecker Habitat. Queen's Printer for Ontario.

OMNR. 1997. Timber Management Guidelines for the Provision of White-Tailed Deer Habitat. Queen's Printer for Ontario.

OMNR. 1998a. A Silvicultural Guide for the Great Lakes-St. Lawrence Conifer Forest in Ontario. Queen's Printer for Ontario.

OMNR. 1998b. A Silvicultural Guide for the Tolerant Hardwood Forest in Ontario. Queen's Printer for Ontario.

OMNR. 1998c. Selected Wildlife and Habitat Features: Inventory Manual. Queen's Printer for Ontario.

OMNR. 2000 Proposed architecture for ecological land classification in Ontario. Final Draft – October 2000.

OMNR. 2001. Forest management guide for natural disturbance pattern emulation, Version 3.1. Ont. Min. Nat. Res., Queen's Printer for Ontario, Toronto. 40 p.

OMNR. 2002. State of the Forest Report, 2001. Toronto: Queen's Printer for Ontario.

OMNR. 2003. Old growth policy for Ontario's Crown forests. OMNR Forest Policy Section. Queen's Printer for Ontario.

OMNR. 2005. Our Sustainable Future. Ministry of Natural Resources. Strategic Directions. Queens Printer for Ontario. 29 pp.

OMNR 2008. BFOLDS 1.0: A spatial simulation model for exploring large scale fire regimes and succession in boreal forest landscapes. Ontario Forest Research Institute. III. Series: Forest research report (Online); no. 152

OMNR 2009. Ontario's Woodland Caribou Conservation Plan. Queen's Printer for Ontario. ISBN 978-1-4435-1381-4 Print 24 pp.

OMNR, 2009b. Cervid Ecological Framework. Ontario Ministry of Natural Resources.

OMNR 2010. Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales. Queen's Printer for Ontario.

Ontario Forest Accord 1999.

Perera, A.H. and D.J.B. Baldwin. 2000. Spatial patterns in the managed forest landscape of Ontario. Pages 74-99.In: A.H. Perera, D.L. Euler and I.D. Thompson (editors). Ecology of a Managed Terrestrial Landscape: Patterns and Processes in Forest Landscapes of Ontario. UBC Press, Toronto.

Perera, A.H., L.J. Buse, and M.G. Weber (eds). 2004. Emulating Natural Forest Landscape Disturbances: Concepts and Applications. Columbia University Press. 352 pages.

Pinto, F. and S.M. Romaniuk. 2002. Presettlement forest cover in northeastern Ontario. Pp. 59-61 in Emulating Natural Forest Landscape Disturbances: Concepts and Applications Popular Summaries. Buse, L.J. and A.H. Perera, comp. Sault Ste. Marie, ON. May 11-16, 2002. Ont. Min. Nat. Resour., Ont. For. Res. Inst., For. Res. Inf. Pap. No. 149. 100 p.

Podur, Justin P., D. L. Martell and K. Knight. 2002. Statistical quality control analysis of forest fire activity in Canada. Can. J. For. Res. 32(2): 195-205.

Quinn, N.W.S. 2004. The presettlement hardwood forests and wildlife of Algonquin Provincial Park: A synthesis of historic evidence and recent research. Forestry Chronicle 80. pp 705-717.

Racey, G., A. Harris, L. Gerrish, E. Armstrong, J. McNicol and J. Baker. 1999. Forest management guidelines for the conservation of woodland caribou: a landscape approach. MS draft. Ontario Ministry of Natural Resources, Thunder Bay, Ontario. 69 pp.

Rempel, R.S., P. Elkie, A. R. Rodgers and M. J. Gluck. 1997. Timber-management and natural-disturbance effects on moose habitat: landscape evaluation. J. Wildl. Manage. 61:517-524.

Rempel, R. S., J. Baker, P. C. Elkie, M. J. Gluck, J. Jackson, R. S. Kushneriuk, T. Moore and A. H. Perera. 2007. Forest policy scenario analysis: sensitivity of forest songbirds to changes in mature forest cover amount, composition, and configuration. Avian Conservation and Ecology - Écologie et conservation des oiseaux XX(YY): ZZ. [online] URL: http://www.ace-eco.org/volXX/issYY/artZZ/.

Rempel, R. S., J. Baker, G. Brown, J. Churcher, M. Gluck, B. Naylor. 2011. Effectiveness Monitoring of Forest Management Guides: Strategic Direction. Information Paper CNFER IP-006. Ontario Ministry of Natural Resources, Centre for Northern Forest Ecosystem Research, Thunder Bay, Ontario, Canada. 18pp.

Renecker. L.A. and C.C. Schwartz. 1998. Food Habits and feeding behaviour. In Ecology and management of the North American moose. Franzmann, A.W. and C.C. Schwartz, Eds. Smithsonian Inst. Press. Wash. and London. pp 403-439.

Rowe, J.S. and J.W. Sheard. 1981 Ecological Land Classification: a survey approach. Environmental Management 5:451-64.

Spittlehouse, D.L. 2005. Integrating climate change adaptation into forest management. The Forestry Chronicle 81:91-95.

Stankey, George H., Clark, Roger N., Bormann, Bernard T. 2005. Adaptive management of natural resources: theory, concepts, and management institutions. Gen. Tech. Rep. PNW-GTR-654. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 73 p.

Suffling, R. B. Smith, and J.D. Molin. 1982. Estimating past forest age distributions and disturbance rates in north-western Ontario: a demographic approach. Journal of Environmental Management 14:45-56.

Ter-Mikaelian, M.T., S.J. Colombo, and J. Chen. 2008. Fact and fantasy about forest carbon. For. Chron. 84: 166-171.

Voigt, D.R., G. Deyne, M. Malhiot, B. Ranta, B. Snider, R. Stefanski, and M. Strickland. 1992. White-tailed deer in Ontario: background to a policy. Ont. Min. Nat. Res., Wildl. Policy Br. Draft Document. 83 p.

Walters C. 1986. Adaptive Management of Renewable Resources. Macmillan Publishing Co., New York.

# Appendix 1. Landscape Guide Milestones for Landscape Guide Region 4S/3S

**Table A1. Landscape Guide Region 4S/3S – Milestones for the Kenora Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Decrease and maintain within the IQR | Decrease | Decrease | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Move towards and maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages Conifer | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| Habitat | Habitat for forest dwelling woodland caribou within local population range(s) | Refuge habitat | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Winter used and preferred habitat | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Texture/arrangement of winter habitat | 6,000 and 30,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes |

**Table A2. Landscape Guide Region 4S/3S – Milestones for the Whiskey Jack Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Decrease and maintain within the IQR | Decrease | Decrease | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages Conifer | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| Habitat | Habitat for forest dwelling woodland caribou within local population range(s) | Refuge habitat | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Winter used and preferred habitat | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | | Texture/arrangement of winter habitat | 6,000 and 30,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes |

**Table A3. Landscape Guide Region 4S/3S – Milestones for the Whitefeather Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages Conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| Habitat | Habitat for forest dwelling woodland caribou within local population range(s) | Refuge habitat | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Winter used and preferred habitat | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Texture/arrangement of winter habitat | 6,000 and 30,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes |

**Table A4. Landscape Guide Region 4S/3S – Milestones for the Trout Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Decrease and maintain within the IQR | Decrease | Maintain | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages Conifer | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| Habitat | Habitat for forest dwelling woodland caribou within local population range(s) | Refuge habitat | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Winter used and preferred habitat | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Texture/arrangement of winter habitat | 6,000 and 30,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes |

## Table A5. Landscape Guide Region 4S/3S – Milestones for the Wabigoon Forest.

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Decrease and maintain within the IQR | Decrease | Decrease | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages Conifer | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |

**Table A6. Landscape Guide Region 4S/3S – Milestones for the Red Lake Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages Conifer | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| Habitat | Habitat for forest dwelling woodland caribou within local population range(s) | Refuge habitat | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | | Winter used and preferred habitat | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | | Texture/arrangement of winter habitat | 6,000 and 30,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes |

**Table A7. Landscape Guide Region 4S/3S – Milestones for the Lac Seul Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Decrease and maintain within the IQR | Decrease | Decrease | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages Conifer | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| Habitat | Habitat for forest dwelling woodland caribou within local population range(s) | Refuge habitat | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Winter used and preferred habitat | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Texture/arrangement of winter habitat | 6,000 and 30,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes |

**Table A8. Landscape Guide Region 4S/3S – Milestones for the Dryden Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Decrease and maintain within the IQR | Decrease | Maintain | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages Conifer | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |

# Appendix 2. Landscape Guide Milestones for Landscape Guide Region 4W

**Table A9. Landscape Guide Region 4W – Milestones for the Crossroute Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Decrease and maintain within the IQR | Decrease | Decrease | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages Conifer | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |

**Table A10. Landscape Guide Region 4W – Milestones for the Sapawe Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Decrease and maintain within the IQR | Decrease | Maintain | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages Conifer | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |

**Table A11. Landscape Guide Region 4W – Milestones for the Dog River - Matawin Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Decrease and maintain within the IQR | Decrease | Maintain | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages Conifer | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |

**Table A12. Landscape Guide Region 4W – Milestones for the Lakehead Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Decrease and maintain within the IQR | Decrease | Decrease | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages Conifer | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |

# Appendix 3. Landscape Guide Milestones for Landscape Guide Region 3W

**Table A13. Landscape Guide Region 3W – Milestones for the Caribou Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Decrease and maintain within the IQR | Decrease | Decrease | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages Conifer | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| Habitat | Habitat for forest dwelling woodland caribou within local population range(s) | Refuge habitat | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Winter used and preferred habitat | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Texture/arrangement of winter habitat | 6,000 and 30,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes |

**Table A14. Landscape Guide Region 3W – Milestones for the English River Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Decrease and maintain within the inter-quartile range (IQR) | Decrease | Maintain | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages Conifer | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| Habitat | Habitat for forest dwelling woodland caribou within local population range(s) | Refuge habitat | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Winter used and preferred habitat | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Texture/arrangement of winter habitat | 6,000 and 30,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes |

**Table A15. Landscape Guide Region 3W – Milestones for the Black Spruce Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Decrease and maintain within the IQR | Decrease | Maintain | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages Conifer | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| Habitat | Habitat for forest dwelling woodland caribou within local population range(s) | Refuge habitat | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | | Winter used and preferred habitat | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Texture/arrangement of winter habitat | 6,000 and 30,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes |

**Table A16. Landscape Guide Region 3W – Milestones for the Lake Nipigon Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Decrease and maintain within the IQR | Decrease | Decrease | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages Conifer | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| Habitat | Habitat for forest dwelling woodland caribou within local population range(s) | Refuge habitat | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | | Winter used and preferred habitat | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Texture/arrangement of winter habitat | 6,000 and 30,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes |

**Table A17. Landscape Guide Region 3W – Milestones for the Ogoki Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Decrease and maintain within the IQR | Decrease | Decrease | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages Conifer | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| Habitat | Habitat for forest dwelling woodland caribou within local population range(s) | Refuge habitat | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Winter used and preferred habitat | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Texture/arrangement of winter habitat | 6,000 and 30,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes |

## Table A18. Landscape Guide Region 3W – Milestones for the Kenogami Forest.

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Decrease and maintain within the IQR | Decrease | Decrease | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages Conifer | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| Habitat | Habitat for forest dwelling woodland caribou within local population range(s) | Refuge habitat | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | | Winter used and preferred habitat | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Texture/arrangement of winter habitat | 6,000 and 30,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes | Move towards mean focusing on 60% and greater proportion classes |

**Table A19. Landscape Guide Region 3W – Milestones for the Big Pic Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Increase and maintain within the IQR | increase | Increase | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Decrease and maintain within the IQR | Decrease | Decrease | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages spruce and pine<br>PjDom, PjMx1, SbDom and SbMx1 | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Increase and maintain within the IQR | Increase | Move towards mean | N/A |

**Table A20. Landscape Guide Region 3W – Milestones for the Black River Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Mature and late balsam fir mixed | Area (ha) | Maintain within the inter-quartile range (IQR) | Maintain | Maintain | Maintain |
| | | Mature and late lowland spruce and low other conifer | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | | Mature and late conifer and conifer mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and late hardwood and hardwood mixedwood | Area (ha) | Decrease and maintain within the IQR | Decrease | Decrease | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition estimate | Increase | Increase | Increase |
| | Upland pine and spruce forest | All ages Conifer | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Increase and maintain within the IQR | Increase | Move towards mean | N/A |

# Appendix 4. Landscape Guide Milestones for Landscape Guide Region 3E

**Table A21. Landscape Guide Region 3E – Milestones for the Abitibi River Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Immature and older pine | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and older upland conifer | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Immature and older hardwood and immature mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and older mixedwood | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Mature and older lowland conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition | Increase | Increase | Increase |
| | Forest Unit Groupings | All ages Conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| Habitat | Habitat for forest dwelling woodland caribou within local population range(s) | Suitable habitat (winter) | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Mature Conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Texture/arrangement of suitable and mature conifer habitat | 6,000 and 30,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean focusing on > 28% (mature conifer) and 75% (suitable) classes | Move towards mean focusing on > 28% (mature conifer) and 75% (suitable) classes | Move towards mean focusing on > 28% (mature conifer) and 75% (suitable) classes |

**Table A22. Landscape Guide Region 3E – Milestones for the Gordon Cosens Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Immature and older pine | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and older upland conifer | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Immature and older hardwood and immature mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and older mixedwood | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Mature and older lowland conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition | Increase | Increase | Increase |
| | Forest Unit Groupings | All ages Conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| Habitat | Habitat for forest dwelling woodland caribou within local population range(s) | Suitable habitat (winter) | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Mature conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Texture/arrangement of suitable and mature conifer habitat | 6,000 and 30,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean focusing on > 28% (mature conifer) and 75% (suitable) classes | Move towards mean focusing on > 28% (mature conifer) and 75% (suitable) classes | Move towards mean focusing on > 28% (mature conifer) and 75% (suitable) classes |

**Table A23. Landscape Guide Region 3E – Milestones for the Hearst Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Immature and older pine | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Mature and older upland conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Immature and older hardwood and immature mixedwood | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | | Mature and older mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and older lowland conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition | Increase | Increase | Increase |
| | Forest Unit Groupings | All ages Conifer | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| Habitat | Habitat for forest dwelling woodland caribou within local population range(s) | Suitable habitat (winter) | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Mature conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Texture/arrangement of suitable and mature conifer habitat | 6,000 and 30,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean focusing on > 28% (mature conifer) and 75% (suitable) classes | Move towards mean focusing on > 28% (mature conifer) and 75% (suitable) classes | Move towards mean focusing on > 28% (mature conifer) and 75% (suitable) classes |

**Table A24. Landscape Guide Region 3E – Milestones for the Magpie Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Immature and older pine | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Mature and older upland conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Immature and older hardwood and immature mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and older mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and older lowland conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition | Increase | Increase | Increase |
| | Forest Unit Groupings | All ages Conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |

**Table A25. Landscape Guide Region 3E – Milestones for the Martel Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Immature and older pine | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Mature and older upland conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Immature and older hardwood and immature mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and older mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and older lowland conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition | Increase | Increase | Increase |
| | Forest Unit Groupings | All ages Conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |

**Table A26. Landscape Guide Region 3E – Milestones for the Nagami Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Immature and older pine | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and older upland conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Immature and older hardwood and immature mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and older mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and older lowland conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition | Increase | Increase | Increase |
| | Forest Unit Groupings | All ages Conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |

**Table A27. Landscape Guide Region 3E – Milestones for the Pineland Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Immature and older pine | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Mature and older upland conifer | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | | Immature and older hardwood and immature mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and older mixedwood | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Mature and older lowland conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition | Increase | Increase | Increase |
| | Forest Unit Groupings | All ages Conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |

**Table A28. Landscape Guide Region 3E – Milestones for the Romeo Malette Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Immature and older pine | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Mature and older upland conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Immature and older hardwood and immature mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and older mixedwood | Area (ha) | Increase and maintain within the IQR | Increase | Maintain | Maintain |
| | | Mature and older lowland conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition | Increase | Increase | Increase |
| | Forest Unit Groupings | All ages Conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |

**Table A29. Landscape Guide Region 3E – Milestones for the Timiskaming Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Immature and older pine | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and older upland conifer | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Immature and older hardwood and immature mixedwood | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and older mixedwood | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Mature and older lowland conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition | Increase | Increase | Increase |
| | Forest Unit Groupings | All ages Conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |

**Table A30. Landscape Guide Region 3E – Milestones for the White River Forest.**

| CFSA Objective Category | Landscape Guide Indicator Group | Landscape Guide Indicator | Measurement (units) | Milestones | | | |
|---|---|---|---|---|---|---|---|
| | | | | Directional Statement | Short (10 years) | Medium (20 years) | Long (100 years) |
| Structure and Composition | Landscape classes | Immature and older pine | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | | Mature and older upland conifer | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Immature and older hardwood and immature mixedwood | Area (ha) | Decrease and maintain within the IQR | Decrease | Maintain | Maintain |
| | | Mature and older mixedwood | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | | Mature and older lowland conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Old growth forest | Old growth by Forest Management Plan forest unit or appropriate grouping | Area (ha) | Increase and maintain within the IQR | Increase | Increase | Maintain |
| | Red and white pine forest | All ages red and white pine forest units | Area (ha) | Increase to pre-industrial condition | Increase | Increase | Increase |
| | Forest Unit Groupings | All ages Conifer | Area (ha) | Maintain within the IQR | Maintain | Maintain | Maintain |
| | Young forest | Young forest | Area (ha) | Move towards and/or maintain within the IQR | Move towards or maintain as applicable | Move towards or maintain as applicable | Move towards or maintain as applicable |
| Pattern | Texture of mature and old forest | Texture of mature and old forest | 500 and 5,000 ha hexagon frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |
| | Young forest patch size | Young forest patch size | Patch size frequency distribution | Move towards and/or maintain within the SRNV | Move towards mean | Move towards mean | N/A |

## Notes

## Notes

## Notes

Ministry of Natural Resources

Ontario

Natural. Valued. Protected.

MNR Number: 62826 (Print)
MNR Number: 62827 (PDF)

ISBN: 978-1-4606-3670-1 (Print)
ISBN: 978-1-4606-3671-8 (PDF)